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13-53181



ENV

0110300003  
New Jersey Zinc  
(DePue)  
SF/Tech

February 28, 2013

US EPA RECORDS CENTER REGION 5



461587

Ms. Charlene Falco  
Project Manager  
Federal Site Remediation Section  
Illinois Environmental Protection Agency  
1021 North Grand Avenue East  
Springfield, IL 62794

**Re: 0110300003 – Bureau County  
New Jersey Zinc /Mobil Chemical  
Superfund/Technical Reports  
Operable Unit 3 – On-Site Soils and Groundwater**

**RECEIVED**

**MAR 01 2013**

**IEPA-BOL-FSRS**

Dear Ms. Falco:

ENVIRON International Corporation (ENVIRON), on behalf of the DePue Group, has prepared this response to the Illinois Environmental Protection Agency's (IEPA's) December 4, 2012 comments, which were prepared in response to ENVIRON's Preliminary Phase II Remedial Investigation report, OU3: On-Site Soils and Groundwater, DePue Site, DePue, Illinois Volumes 1 and 2 response to IEPA comments, dated August 13, 2012. Only those comments that were not accepted by IEPA in the December 4, 2012 response evaluation have been incorporated into the responses below. IEPA's original comments and response evaluations are reproduced below in italic type with ENVIRON's original response and evaluation response following each comment in regular type. Upon IEPA approval of these evaluation responses, a revised Preliminary Phase II Remedial Investigation Report will be submitted.

## **General Comments**

### **General Comments**

**Comment 2.** *One of the requirements of a remedial investigation is to adequately identify various sources at the site. While the lithopone ridges, slag pile, and below grade slag pile in the UPSEA are clearly sources, the RI does not address or identify the potential contribution of the slag/residue found throughout the plant area, including the western area, or the plant residue located throughout the Village of DePue (for example, the plant material located between the railroad tracks and the homes on Fourth St.). How does the material in these areas contribute to ongoing groundwater impacts?*

**Response:** The Phase II RI was conducted in accordance with the IEPA-approved Phase II RI Work Plan in response to the data gaps that existed at conclusion of the IEPA-approved Phase I RI report. The issues considered to be a data gap were summarized in the Phase II RI Work Plan and investigated as part of the Phase II RI. Material, potentially from the plant, located in the Village is being investigated along with off-site soils as part of the OU4 investigation. Groundwater conditions off-site are being evaluated as part of OU3. Based on the groundwater data from within the Village of DePue, impacts to groundwater from potential plant residue within the village is *de minimis* except for

the area around the Former Municipal Dump and the South Ditch, which were evaluated during the Phase II RI and will be evaluated further within the Design Studies (DS) for OU3.

**Illinois EPA Review:** *The report should include the site-related material along the face of the shoreline on the north side of the lake as source material. This material is contributing metals (e.g. cadmium, lead, and zinc) above the HCOPC and ECOPC screening criteria to groundwater that emerges as seeps in SP-03, -04, -05, -06, -07, -08, and -10.*

**Review Response:** The elevated concentrations of cadmium, lead, and zinc in some shoreline seeps were not observed in upgradient Lower Aquifer monitoring wells. Based on visual observations of fill material on the shoreline, we have surmised that the fill material consisting of concrete, bricks, potential plant-related materials, tires, abandoned machinery, and miscellaneous debris, may be a source or may be incrementally increasing concentrations of these metals at some of the shoreline seep locations. The lowland soils in Division Street Drain and Lowland Portion of the Southeast Area in the vicinity of seeps SP-06 through SP-10 were evaluated as part of OU5 investigation activities. If needed, further evaluation of the shoreline seeps and shoreline will be performed during remedy design. The following text will be added at the end of Section 5.2.4 and in Section 7: "The elevated concentrations of cadmium, lead, and zinc in some shoreline seeps were not observed in upgradient Lower Aquifer monitoring wells. Based on visual observations of fill material on the shoreline, the fill material consisting of concrete, bricks, potential plant-related materials, tires, abandoned machinery, and miscellaneous debris, may be a source or may be incrementally increasing concentrations of these metals at some of the shoreline seep locations."

**Comment 3.** *The Phase 1 and 2 investigations have generally been limited to analyses for metals, major cations and anions, nitrogen, phosphorous, and sulfur compounds, and PAHs. There were operations conducted historically on site that may have contributed other types of contaminants. While a certain number of samples have been analyzed for a broader range of contaminants, it is not clear if those samples were randomly chosen or were associated with certain locations on the facility where such contaminants were more likely to occur. For instance, was the presence of PAHs and dioxins assessed in soil samples taken from the railyard area? Were samples taken in and around areas associated with transformers analyzed for PCBs? Illinois EPA understands that the answers to these questions may occur in earlier documents such as the Golder reports. If this is the case, the rationale for such decisions should be included in the RI. If no such decisions were made and samples taken for a broader range of contaminants were randomly chosen, consideration should be given to collecting a few additional soil samples to document the presence or absence of other contaminants reasonably expected to be present based on operations or activities.*

**Response:** Analyses of various media collected from site investigations have not been limited. Samples were collected for a broad range of analytes during the Site Inspection performed in 1992, the zinc processing waste and demolition debris sampling program in April 1998, and the supplemental zinc processing waste sampling program in August 1999 as follows:

- During the Site Inspection, one of the three soil samples collected from the FPSA soil was analyzed for the full Target Compound List. This sample was collected from "near above-ground fuel tanks west of Mobil Shop."
- During the zinc processing waste and demolition debris sampling program, 37 of the 61 soil samples collected from the FPSA soil were analyzed for VOCs and PAHs (in addition to inorganic analyses). These samples appear to have been collected from locations where contamination was suspected rather than from random locations.

- During the supplemental zinc processing waste sampling program, two of the eight soil samples collected from the FPSA soil were analyzed for VOCs and PAHs (in addition to inorganic analyses). These samples appear to have been collected from locations where contamination was suspected rather than from random locations.

Based on the historical process review and results of the previous investigations, the Phase I RI sampling and analysis plan was developed to analyze all samples for an indicator list of parameters, with a subset of samples (approximately 10%) analyzed for the more comprehensive USEPA Target Compound List/ Target Analyte List parameters to identify other constituents that might be present in soil and groundwater within the Study Area.

Given that the sample collection for other contaminants performed prior to the Phase I and Phase II RIs was performed at focused locations rather than randomly selected locations to fill data gaps that were presented and agreed to by IEPA. The DePue Group does not believe that any other data gaps exist that cannot be filled as part of the Design Study. Those investigations would be focused on remedy design, not defining the nature and extent of impacts from the Former Plant Site (OU3).

**Illinois EPA Review:** *The response does not include any reference to PCB or dioxin sample analyses or locations, as specifically requested in the original comment. Please include in the discussion a rationale for excluding these chemicals from the analytical program (do not say "because they were not included in the IEPA-approved work plan").*

**Review Response:** PCBs are included in USEPA's Target Compound List, and therefore, 36 of the Phase I RI soil samples were analyzed for PCBs in accordance with the IEPA-approved Phase I RI Work Plan. PCBs were detected in only 6 locations. The maximum total PCB concentration was detected in location B-5 in the Lithopone Ridges Area at a depth of 5 to 7.5 feet bgs. At this location, the detected total Aroclor concentration was 0.198 mg/kg and comprised 0.135 mg/kg of Aroclor 1254 and 0.063 mg/kg of Aroclor 1260. During the Phase II RI, PCBs were not detected in the 15 soil samples analyzed. Based on these results, the DePue Group does not feel that additional sampling for PCBs is warranted. Dioxins were not analyzed during the Phase I or Phase II soil sampling because they were not identified as potential concerns during the development of the work plans for the Phase I or Phase II sampling. It is assumed that the concern with dioxin in the railyard area is related to the potential for dioxins to be present in the wood preservative pentachlorophenol. Dioxin can be unintentionally produced as a byproduct during pentachlorophenol production. [Source: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. December 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. p 2.] Pentachlorophenol is included in USEPA's Target Compound List, and therefore, 36 of the Phase I RI soil samples and 15 of the Phase II RI soil samples were analyzed for pentachlorophenol in accordance with the IEPA-approved Work Plans. Pentachlorophenol was not detected in the soil samples analyzed including three locations (i.e., G-7, H-6 and H-7) that are located in the former railyard area. Also, dioxins are generally found in the environment with other structurally related chlorinated compounds such as PCBs. [Source: U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry. December 1998. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. p 3.] As discussed previously, PCBs were detected in only a few locations at low concentrations. Given the lack of significant PCB or pentachlorophenol concentrations at the site, it is unlikely that dioxins are a noteworthy issue, and the DePue Group does not consider the lack of dioxin analysis a data gap.

**Comment 6.** *Section 2.2.1, Primary Zinc Smelting, 2<sup>nd</sup> paragraph, page 8, and Figure 2-5: The report text states that prior to the installation and operation of the lake water line, groundwater from*

*several wells installed on site may have been used to supply water. The locations of these abandoned wells should be shown on Figure 2-5.*

**Response:** Figure 2-5 will be revised with the locations of the abandoned water wells shown on historic facility drawings from 1907 and 1966. Sufficient historical information is not available to pair these well locations with the well logs reported in the water well search included in Appendix C of the Preliminary Phase II RI Report.

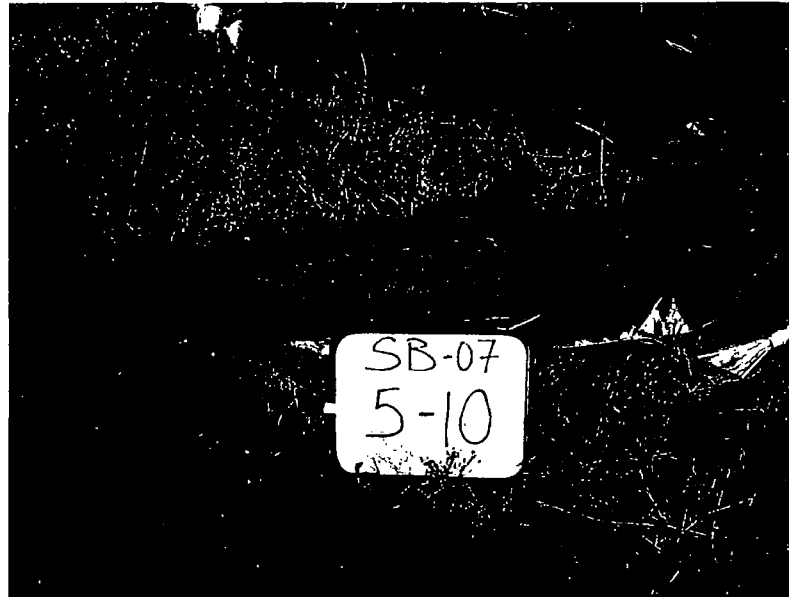
**Illinois EPA Review:** *The response states that sufficient historical information is not available to pair these well locations with the well logs included in Appendix C of the RI report. Is there sufficient historical information to determine whether these were Lower Aquifer or bedrock wells? Any available historical information for these wells should be included in the report.*

**Review Response:** Known available historical information on water wells from public sources was included in Appendix C of the RI Report. In addition to the well logs, a table was included that summarizes the township, range, section, plot, owner, driller, date drilled, well depth, well type, aquifer, and status of each well as reported on the well log. The table also contains the source from which each log was obtained and any pertinent notes. The DePue Group is not aware of any additional historical information on these wells that would provide further details regarding the geology. The well depths listed in Table I-1 of Appendix C of the RI Report for wells 18, 19, and 22 that are identified as owned by Mineral Point Zinc are 1,000 feet deep or greater. Well records are available for wells 19 and 22 and indicate that they are bedrock wells; however, well 19 appears to be a repeated record for the DePue Village well, which is not located in the Former Plant Site Area. The only available information for well 18 is a sampling certificate from 1906 that identifies the well as being 1,000 feet deep. Based on the depth to bedrock at the site, well 18 is also a bedrock well. The remaining wells listed in Table I-1 of Appendix C as owned by Mineral Point Zinc or New Jersey Zinc Co. are most likely Lower Aquifer wells. The revised Figure 2-5 is included in Attachment 1.

**Comment 9.** *Section 3.4.1, Geotechnical Testing of Non-Native Material, 1<sup>st</sup> bullet, page 16:*

*b) The matrix subtype for sample DPSB-07-8-10 is incorrectly identified as aquitard. The log for this boring show this interval to be fill. Please revise Table 3-2.*

**Response:** A review of the field notebook for soil boring SB-07 indicates that the sandy silt material encountered from 2 to 10 feet below ground surface (bgs) was conservatively classified as fill because it appeared that sandy silty material may have been disturbed. A photograph of the material recovered from 5 to 10 feet bgs at SB-07 is provided below:



Furthermore, similar material encountered at nearby soil boring CSB-4 advanced as part of the CAMU investigation was not classified as fill and the hydraulic conductivity of  $5.18 \times 10^{-6}$  centimeters per second (cm/sec) measured from 8 to 10 feet bgs at SB-07 is within the range of the hydraulic conductivity of the aquitard materials as shown in Table 4-9. Therefore, the material encountered from 2 to 10 feet bgs at SB-07 is considered aquitard material and a revised boring log for SB-07 will be included in the revised Preliminary Phase II RI Report.

**Illinois EPA Review:** Please provide a copy of the field logbook referenced above for SB-07. Illinois EPA's contractor, E&E, also logged this material as reworked possible fill. It looks disturbed in the photo provided above. Boring SB-46 located just west of SB-07 (closer than CSB-4) logged similar soil down to 9 ft. as fill. Based on the original interpretation of the soil material as fill there would be no aquitard above the Lower Aquifer at this location. A change of the log would place 8 ft. of aquitard above the Lower Aquifer, a significant difference.

**Review Response:** A copy of the field logbook pages for SB-07 is included as Attachment 2. As stated previously, the material encountered between 2 and 10 feet below ground surface (bgs) was classified as fill because while the material appeared to be naturally occurring, the soil appeared as though it may have been disturbed. As indicated in the field logbook, there was no anthropogenic material such as slag, lithopone, or debris encountered below 2 feet bgs. In addition, the hydraulic conductivity was within the range measured in the aquitard materials in other locations at the site. Given the hydraulic conductivity and the lack of anthropogenic materials encountered below 2 feet bgs, this material is functioning as an aquitard.

**Comment 10.** Section 3.4.2, Aquitard, 2<sup>nd</sup> bullet, page 16, and Table 3-2: The report text indicates that an aquitard sample was collected at SB-07 for geotechnical testing. The 8-10 foot interval at this boring is fill (per the boring log), not aquitard as shown on Table 3-2. Please revise the text to remove SB-07 from this section of the text.

**Response:** See Response No. 9.

**Illinois EPA Review:** See review of response No. 9

**Review Response:** See review Response 9 above.

**Comment 11.** Section 3.5.1, *Geochemical Test Evaluation*: How are the various geochemical tests, particularly cation exchange capacity (CEC) interpreted? No criteria, no generally accepted range for the soil types present here is provided. Specifically, how did the DePue Group judge the results of CEC analysis and on what basis were the qualifying statements made about each type of material tested?

**Response:** The evaluation of CEC and various geochemical tests involved the comparison of the results for a particular soil type and sample location to the results of other soil types and sample locations. To clarify, the following additional text will be included in Section 3.5.1:

- **Total Organic Carbon:** Organic carbon can directly adsorb heavy metals from solution; therefore, the higher the TOC of the soil, the more heavy metals are adsorbed. The default organic carbon content in Illinois soil is 6,000 mg/kg for surface soil and 2,000 mg/kg for subsurface soil (Title 35 of the Illinois Administrative Code (IAC) Part 742 entitled Tiered Approach to Corrective Action Objectives [TACO]).
- **Cation Exchange Capacity:** CEC is an empirical measurement of the capacity of a soil to hold cations and exchange species of ions in reversible chemical reactions. CEC is an equilibrium process and so only a portion of cations would be removed from a solution by sorption. In general, soils vary in CEC based on the soil types. Examples of CEC values for different soil textures are as follows:<sup>1</sup>

<b>Soil texture</b>	<b>CEC (meq/100g soil)</b>
Sands (light-colored)	3-5
Sands (dark-colored)	10-20
Loams	10-15
Silt loams	15-25
Clay and clay loams	20-50
Clays	3-150
Organic soils	50-100

Clays have varying values for CEC. Smectites (montmorillonite) have the highest CEC (80-150 meq/100 g), followed by illites (15-40 meq 100 g<sup>-1</sup>) and kaolinites (3-15 meq 100 g<sup>-1</sup>). For purposes of this evaluation, a CEC of less than 20 meq/100g is considered low and a CEC of greater than 20 meq/100g is considered high.

- **Acid Volatile Sulfide:** An AVS concentration of less than 1 umol/g is considered low.<sup>2</sup>

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<sup>1</sup> CEC data from :  
<http://broome.soil.ncsu.edu/ssc012/Lecture/topic14.htm>  
<http://soils.tfrec.wsu.edu/webnutritiongood/soilprops/04CEC.htm>

<sup>2</sup> Metals Environmental Risk Assessment Guidance – MERAG (2007)

***Illinois EPA Review:***

- *Total Organic Carbon: The text added to Section 3.5.1 should be more specific - per TACO, the default organic carbon content in Illinois is 6,000 mg/kg for soil within the top meter and 2,000 mg/kg for soil below one meter of the surface.*
- *Cation Exchange Capacity: Per the second reference provided in the response to comments the CEC range for smectites is 80-100 meq/100g, not 80-150 meq/100g as stated in the response. (Access to first reference listed in the response returned a server error.)*
- *Acid Volatile Sulfide: A review of the reference provided (Metals Risk Assessment Guidance, 2007) did not identify AVS concentrations of less than 1  $\mu\text{mol/g}$  as low, please provide the source of this criterion.*

**Review Response:**

**Bullet point 1:** As outlined in Appendix C, Table B of TACO, surface soil is defined as soil within the top meter and subsurface soil is defined as soil below one meter. As requested, the text has been revised to indicate the default organic carbon content is 6,000 mg/kg for soil within the top meter (surface soil) and 2,000 mg/kg for soil below one meter of surface (subsurface soil).

**Bullet point 2:** A copy of the reference is provided in Attachment 3. The text will be revised as follows:

Clays have varying values for CEC. Vermiculites have the highest CEC (100 – 150 meq 100g), followed by smectites (80-100 meq/100 g), followed by illites (10-40 meq 100 g<sup>-1</sup>) and kaolinites (3-15 meq 100 g<sup>-1</sup>)<sup>1</sup>. For purposes of this evaluation, a CEC of less than 20 meq 100g<sup>-1</sup> is considered low and a CEC of greater than 20 meq 100g<sup>-1</sup> is considered high.

**Bullet point 3:** The AVS concentration was compared to the metals concentration in soil. A ratio of AVS to metals of less than one indicates that the precipitation of sulfide minerals is not contributing to metals sequestration<sup>3</sup>. The text will be revised accordingly.

***Comment 16. Section 4.1.1.1, Recent Deposits:***

*b) The updated graphical representation of the aquitard thickness in Figure 4-7 is difficult to interpret. Instead of using color gradations to represent thickness, the map should use contour lines so that the reader can see the specific aquitard thickness at locations around the site, and most importantly, where it may be absent. From the current Figure 4-7 the thickness can only be estimated within  $\pm 3$  ft. Include a zero contour where no aquitard or fill exists.*

**Response:** Figure 4-7 is an updated figure using the same format and intervals as presented in the IEPA-approved Phase I RI.

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<sup>3</sup> McGrath, Joy A., Paul R. Paquin, Dominic M. Di Toro, Use of the SEM and AVS Approach in Predicting Metal Toxicity in Sediments. Fact Sheet on Environmental Risk Assessment No. 10. International Council on Mining and Metals, February 2002.



**Illinois EPA Review:** *The data presented should be checked and corrected where necessary. For example no aquitard was found at SB-11, SB-38, P-1, P-4 P-2 W-22(s), P-3. If the DePue Group will not produce a usable contour map Illinois EPA will request that its contractor create one for inclusion in the Administrative Record.*

**Review Response:** Figure 4-7 has been revised using Golden Software's Surfer Version 11 surface mapping system software. Because some of the data points shown on the version of Figure 4-7 included in the Phase I RI did not penetrate through the aquitard to provide accurate aquifer thickness data at all of the points shown on the figure, the aquifer thickness shown in the revised Figure 4-7 was prepared as follows:

- A Surfer Grid file of the elevation of the top of the aquitard was created using the top of aquitard elevation data included in Table 4-2C.
- A Surfer Grid file of the elevation of the base of the aquitard was created using data from those soil borings listed in Table 4-2C that penetrated through aquitard. At those locations where the aquitard was not found, the elevation of the base of the aquitard was selected to be the same as the elevation of the top of the aquitard.
- The Grid Math function in Surfer was then used to create an output grid file of the aquitard thickness by subtracting the results of the base elevation grid file from the results of the top elevation grid file at a grid spacing of approximately 60 feet resulting in 5,900 grid nodes.
- The results of the Math Grid output were contoured using the Surfer contour feature and edited as needed using professional judgment.

The areas where peat is present were then overlain on the drawing. A revised Figure 4-7 is included in Attachment 1.

*e) All tables should also provide Easting and Northing coordinates in the State Plane coordinate system.*

**Response:** The DePue Group has performed surveying at the site according to a site-specific coordinate system as previously requested by IEPA. These survey data have been incorporated into the existing site database and data tables, and have been used to accurately place sample locations on site drawings necessary to evaluate the data. Therefore, converting the survey data from the site-specific coordinate system to the state plane coordinate system is not warranted.

**Illinois EPA Review:** *Response is acceptable; however it should be noted that this is not the first request for use of a coordinate system that is compatible with publically available base maps and aerial photos. The DePue Group should provide the CAD or GIS site drawings necessary so that parties other than themselves can easily evaluate the analytical and geotechnical data.*

**Review Response:** IEPA originally approved a site specific coordinate system and after years of data collection requested that we consider using the State Plane coordinate system. As discussed at the time, this would require complete conversion of the site database and related materials. To avoid confusion, the IEPA agreed that we would proceed with use of the site-specific datum. The methods to convert the survey data have previously been provided to IEPA. However, in the interest of progress, the DePue Group has converted the site-specific coordinates to State Plane Coordinates as shown in the Table included in Attachment 4. The coordinates were converted using ESRI ArcGIS and adjusted using the spatial adjustment tools and following the procedure provided by the surveying subcontractor, Chamlin & Associates, which was previously provided to IEPA. The points



were adjusted using the affine transformation method, which can differentially scale, skew, rotate, and translate the data. Three control points with known coordinates in the local and State Plane coordinate systems were used to calculate the transformation. The converted points are in the Illinois State Plane Coordinate system of 1983, West Zone.

*p) Based on a review of the boring log for SB-11, the comment in Table 4-2C "Assumed to be above Aquitard materials" is incorrect. There would appear to be no aquitard present at this boring (similar to MW-37U), and Figure 4-7 should reflect this. The text should also be revised; because there are areas where the aquitard and peat are missing, the aquitard can't be considered "continuous" in the Slag Pile Area.*

**Response:** Table 4-2C will be revised and the text in section 4.1.1.1 will be edited as follows: "...they collectively form a *nearly* continuous low permeability aquitard near the base of the recent deposits *throughout the majority of the FPSA...*"

**Illinois EPA Review:** The use of the words "nearly continuous" with respect to the low permeability aquitard is incorrectly applied here. Individual lenses of fine-grained sediments that are not laterally continuous are "discontinuous". The relationship of these discontinuous lenses to each other collectively forms a low permeability aquitard that reduces vertical migration. Change the second sentence of paragraph two as follows: "*Individual lenses of the fine-grained sediments are discontinuous, however where present they collectively form a low permeability aquitard near the base of the recent deposits that reduces the vertical migration...*"

**Review Response:** The use of the descriptor "nearly continuous" and "discontinuous" are essentially equivalent statements; however, in the interest of progress, the text requested by the IEPA has been incorporated into the second sentence of paragraph two in Section 4.1.1.1.

*t) The text should clarify that Figure 4-7 shows the combined thickness of the peat and the fine-grained sediments (i.e., the native, clays and silts), lumping them both under the term "aquitard". A uniform convention should be adopted for describing the various low permeability materials below the fill: sometimes they are discussed as "aquitard", other times the term "peat/aquitard" or just "peat" is used. Since the peat and fine-grained sediments are not always coincident, and they have differing geochemical properties a distinction should be made in the text and clarified on the figures, possibly by showing the boundaries of the peat on the Aquitard Thickness map.*

**Response:** The following text will be added to the end of the first paragraph under 4.1.1.1: "The combined thickness of the peat and the fine-grained materials (clays and silts) are collectively identified as the "aquitard." The limits of the peat are also shown on Figure 4-7 and Figure 4-11.

**Illinois EPA Review:** The added text is acceptable; the limits of the peat are not shown on Figure 4-7, but should be.

**Review Response:** The limits of the peat shown in Figure 4-11 have been added to Figure 4-7 (Attachment 1).

**Comment 17.** Section 4.1.1.1, Recent Deposits, second paragraph: *How can individual lenses that are not laterally continuous collectively form a continuous aquitard?*

**Response:** As presented in the IEPA-approved Phase I RI and the Preliminary Phase II RI, the interlayering of the individual lenses of clay, silt, and fine sand, as outlined in the text excerpt below, form a continuous aquitard.

“Even though individual lenses of the fine-grained sediments are not laterally continuous, they collectively form a continuous low permeability Aquitard near the base of the recent deposits, limiting vertical migration of groundwater between the permeable, saturated units within the shallow recent deposits and the underlying deposits.”

**Illinois EPA Review:** Refer to review of response to Comment 16(p).

**Review Response:** The second paragraph of Section 4.1.1.1 has been edited as follows and also includes changes relative to Comment 16p above:

“In general, the recent deposits are comprised mostly fine-grained sediments (clays, silts, and fine sands) with lesser occurrences of sand or gravel. The individual lenses of the fine-grained sediments are discontinuous, however where present they collectively form a low permeability aquitard (clays, silts, and peat with interstitial sand lenses) near the base of the recent deposits that reduces the vertical migration of groundwater between the permeable, saturated units within the shallow recent deposits and the underlying deposits. A summary of the descriptions and thickness measurements of the aquitard from the Phase I RI and Phase II RI is provided in Table 4-2C and an updated graphic representation of the aquitard thickness, based on the Table 4-2C data, is shown on Figure 4-7.”

**Comment 19.** Section 4.1.2.2: Figure 4-1 [sic] is described in the text as providing the dimensions of the lithopone ridges, but it does not. Please include this information.

**Response:** The text references Figure 1-4 and will be revised as follows: “The location and dimensions of the Lithopone Ridges Area are shown on Figure 1-4.” The dimensions of the Lithopone Ridges Area are provided by the scale bar shown on Figure 1-4.

**Illinois EPA Review:** Response is acceptable. However, the average dry density of the lithopone (per values in Table 4-1) is approximately 63.8 lbs/ft<sup>3</sup>, not 68.3 lbs/ft<sup>3</sup> as indicated in the text.

**Review Response:** The average dry density of the lithopone included in the response was a result of inadvertently transposing of the “3” and the “8”. The dry density identified in the text has been revised to 63.8 lbs/ft<sup>3</sup> based on the calculations shown in Table 4-1.

**Comment 21.** Section 4.1.2.3, General Fill Material on FPSA, page 33: The mass of general fill was reported as 751,500 short tons. The Western and Eastern Areas also include a volume of Lithopone (see Phase I Report) that is not discussed in the text. A table should be used, similar to that used in Phase 1 that incorporates the new dry density values for slag, fill, and Lithopone as taken from Table 4-1. The total mass we calculate is 749,866 (round to 750,000) short tons instead of 751,500 shown in the report.

	Volume (cy)			
	Slag	Fill	Lithopone	Total
Western Area	119,700	175,300	0	295,000
Eastern Area	116,900	227,500	6,700	351,100
Total	236,600	402,800	6,700	646,100

	Volume (cy)			
	Slag	Fill	Lithopone	Total
Total Mass (short ton)	194,329	549,762	5,775	749,866

**Response:** The breakdown of the estimated fill material volume and the calculated approximate mass of the general fill material on the FPSA (Eastern and Western Areas) will be incorporated into the revised report text as follows:

Area	Approximate Volume (CY)			
	Slag	General Fill	Lithopone	Total
Western Area	119,700	175,300	0	295,000
Eastern Area	116,900	227,500	6,700	351,100
Total	236,600	402,800	6,700	646,100
Average Dry Density (lbs/ft <sup>3</sup> )	60.84	101.1	<del>68.3</del> 63.8	--
Approximate Total Mass (short tons)	194,329	549,761	5,771	749,861

The approximate volumes are equivalent to the volumes reported in the Phase I RI Report.

**Illinois EPA Review:** Response is acceptable. However, the average dry density of the lithopone (per values in Table 4-1) should be listed as 63.8 lbs/ft<sup>3</sup>, not 68.3 lbs/ft<sup>3</sup> as indicated in the table above (however, the mass for lithopone is correct).

**Review Response:** The "3" and the "8" for the average dry density of the Lithopone were inadvertently transposed in the table above. The dry density of the lithopone in the table has been changed to 63.8 lbs/ft<sup>3</sup>.

**Comment 22.** Section 4.1.2.4, Southeast Area and Former Municipal Dump, page 33:

a) The maximum thickness of fill in the Southeast Area is unknown. Boring SB-25 terminated at 20 feet and was still in slag and retort. The text should be revised to make the distinction between observed thickness and known total thickness.

**Response:** The text indicated that the maximum observed fill thickness in the UPSEA was approximately 20 feet. Additional text will be added as follows for clarification: "The maximum fill thickness in the UPSEA is unknown, but is not expected to be much greater than 20 feet based on the fill thicknesses of 15 feet or less measured in the surrounding soil borings."

**Illinois EPA Review:** While the Phase II report text did indicate that the maximum observed thickness is approximately 20 feet, there is limited evidence to support the assumption that the maximum thickness is limited to approximately 20 feet. The text should be revised as follows: "The maximum fill thickness observed in test pits was 14 feet. However due to limitations of the backhoe, not all test pits were able to penetrate the full thickness of the fill. Therefore the maximum fill thickness is unknown".

**Review Response:** Both test pits and soil borings were advanced in the Former Municipal Dump. Based on the data collected, the text will be revised as follows: "The maximum fill thickness observed in the municipal dump test pits was 14 feet; however, due to limitations of the backhoe, test pits TP-120, TP-121, TP-122 and TP-128 were not able to penetrate the full thickness of the fill. TP-120 is located near MW-36T where the fill thickness was observed to be approximately 10 feet; TP-121 is located near SB-25 where the fill thickness was observed to be greater than 20 feet; TP-122 is located near MW-28T where the fill thickness was approximately 15 feet; and TP-128 is located near SB-26 where the fill thickness was approximately 12 feet. Based on the test pits and soil borings advanced in the former municipal dump, the maximum thickness of the fill in the vicinity of TP-121 and SB-25 is greater than 20 feet. The exact maximum thickness at these locations is unknown."

*b) The fill volume used in this section was 357,500 cy. This value was taken from the Phase 1 Report. Now that it is known that some areas of the dump contain slag/fill in excess of 20 feet, the old volume number should be updated since boring SB-25 was not available when the original Phase 1 volume was calculated.*

**Response:** A fill thickness of 20 feet or more in the UPSEA was measured only at SB-25. The fill thickness measured in the soil borings surrounding SB-25 are 15 feet or less, indicating that the fill thickness of 20 feet or more appears to be confined to the area in the immediate vicinity of SB-25. The estimated fill volumes for the Southeast Area were re-calculated using ArcInfo Version 10 using the TIN interpolation method as outlined in the May 16, 2006 response to IEPA comments that was included with the submittal of the Phase I RI Report. The volumes were calculated using data obtained during the Phase I RI and the Phase II RI, including the test pits advanced within the Former Municipal Dump area. The volume calculated includes approximately 228,430 cubic yards of fill, of which approximately 87,615 cubic yards is potentially slag material. The updated estimated volume of total fill is less than the estimated volume of 357,500 cubic yards presented in the Phase I RI. Upon review of the Phase I RI volume calculations, it appears that the calculations presented in the Phase I RI also included sediment in the Lowland Portion of the Southeast Area, which is located in OU5. The updated volumes and mass estimates for the UPSEA are outlined below and do not include sediment in the Lowland Portion of the Southeast Area. The average dry density presented below for slag is the average dry density for slag from samples obtained from SB-25 and SB-26 located in the UPSEA. The average dry density for the general fill is taken from the general fill density for the Slag Pile Area.

**Illinois EPA Review:** *The response should clarify what depth was used in the volume calculation.*

**Review Response:** Based on the data collected, an estimated thickness of 20 feet at SB-25 was used in the volume calculations. The response and report text has been edited as follows:

"The estimated volume of fill material in the southeast area and former municipal dump was re-calculated from that presented in the Phase I RI report using ArcInfo Version 10 using the TIN interpolation method as outlined in the May 16, 2006 response to IEPA comments that was included with the submittal of the Phase I RI Report. The volumes were calculated using data obtained during the Phase I RI and the Phase II RI, including the test pits advanced within the Former Municipal Dump area and assuming a 20 foot fill thickness at SB-25. The volume calculated includes approximately 228,430 cubic yards of fill, of which approximately 87,615 cubic yards is potentially slag material. The updated estimated volume of total fill is less than the estimated volume of 357,500 cubic yards presented in the Phase I RI. Upon review of the Phase I RI volume calculations, it appears that the calculations presented in the Phase I RI also included sediment in the Lowland Portion of the Southeast Area, which is located in OU5. The updated volumes and mass estimates for the UPSEA are outlined below and do not include sediment in the Lowland Portion of the

Southeast Area. The average dry density presented below for slag is the average dry density for slag from samples obtained from SB-25 and SB-26 located in the UPSEA. The average dry density for the general fill is taken from the general fill density for the Slag Pile Area."

c) *The Phase 1 Report had a breakdown of slag volumes versus fill volumes in the Southeast Area. The Phase 2 Report should contain the same type of breakdown with a table similar to the one provided above that includes updated volume and mass estimates for each material.*

Response:

UPSEA	Approximate Volume (CY)	Average Dry density (lb./cf)	Approximate Mass (short tons)
Slag	87,615	47.4	56,065
Fill	140,815	77.3	146,947
Approximate Total	228,430		147,003

**Illinois EPA Review:** *In the table above, the approximate total mass for the UPSEA area is 203,012 short tons; revise table.*

Review Response: The table above has been revised to report 203,012 short tons in the revised report.

**Comment 24.** *Section 4.2.1.1, Non-Native Material, page 33-35:*

*a) It should be noted that only two samples of non-native material were collected from the Lithopone Ridges Area for characterization of acid generating potential. Both samples came from the same borehole (SB30, 4-5 ft. and 5-6 ft.) and were logged as sandy clay (fill) with trace lithopone and gravel. These samples likely are not representative of the bulk of fill material in this area which is comprised of multiple above ground and below ground ridges of lithopone, slag, and general fill, some covered and some not. The samples submitted for acid testing may have been predominantly cover material. Using these sample results to suggest that the non-native material in the Lithopone Ridges Area would not produce acid is questionable. Illinois EPA is satisfied to assume the lithopone ridges would generate acid. If this is not acceptable to the DePue Group, then Illinois EPA would consider this as a data gap and additional data may need to be collected.*

Response: ENVIRON does not agree that a data gap exists and that the lithopone ridges would generate acid based on the following:

- The samples submitted for acid testing were not predominantly cover material. At the SB-30 location, yellow to brown lithopone-like material is present at the ground surface and the area lacks vegetation. While the material encountered at SB-30 was not completely composed of lithopone, lithopone is a component of the material and is representative of the non-native material in the Lithopone Ridges Area.
- Similar material encountered at soil boring C-4 during the Phase I RI was classified as lithopone in Table 6-4 of the IEPA-approved Phase I RI Report.
- During the Phase I RI, 23 lithopone samples were analyzed for paste pH. The paste pH values ranged from 5.46 standard units (SU) to 11 SU, which is greater than 4.5 SU indicating that the lithopone material will not generate acid in the future.

**Illinois EPA Review:**

*First bullet: Samples from boring SB-30 were of non-native material (sandy clay, trace lithopone and gravel). Trace is defined as less than 5% by weight. It is highly unlikely that this sample (with only a "trace" of lithopone) represents the bulk of the waste disposed in the area, or could be considered representative of the material most likely to generate acid, i.e., the lithopone itself. A mixture of cover and trace lithopone and is not representative of the lithopone material (for example, observed at SB-31[1'-10']). Consequently, without acid testing results of the lithopone material, the acid generating potential of this material is unknown and remains a data gap.*

**Review Response:** The testing of lithopone material for acid-generating potential is not a data gap. As summarized in Table C1-8 in the Cumulative Remedial Investigation Site-Wide Phase I Data Report (the "Data Report") (Golder, 2002), four samples [C-3(7.5-10), C-4(5-7.5), C-5(10-14.5), and H-8(0.5-1.5)] identified in the Phase I RI report as "Lithopone" were analyzed for neutralization potential, acid neutralization potential, acid generation potential (calculated), and acid-base potential (calculated). Table C1-8 from the Data Report is included in Attachment 5. The acid generation potential on Table C1-8 was calculated using the total sulfur concentration rather than the pyritic sulfide value; therefore, the acid-base potential shown in the table is conservative (i.e., greater than if the pyritic sulfide value was used). As shown in the table, the calculated conservative acid-base potential or "net neutralization potential" values are greater than -5kg CaCO<sub>3</sub>/t, indicating that the lithopone material is not net acid generating. Table C1-8 from the Data Report will be incorporated into the revised Phase II RI report.

**Illinois EPA Review (continued):**

*Second bullet: Per the boring log, the material at C-4 is described as interbedded clayey silt and silty fine sand, with some small crystals. Similar to SB-30, this non-native material is a mixture, and is not representative of the lithopone material.*

**Review Response:** The description of this material for soil boring C-4 indicates "small prismatic crystals are common". This description is very similar to the description of the material encountered at W-08(S) (dark gray silty clay with some 2mm long, clear, and thin secondary crystals), which IEPA has classified as Lithopone in Comment 27. The material sampled at soil boring C-4 during the Phase I RI was classified as Lithopone in Table 6-4 of the IEPA-Approved Phase I RI. Re-classification of the materials summarized in Table 6-4 of the Phase I RI is not necessary.

**Illinois EPA Review (continued):**

*Third bullet: Based on the Phase I paste pH results, the non-native material in the Lithopone Ridges Area will not generate acid in the future. We were able to find boring log descriptions of only 7 of the 23 "lithopone" samples mentioned in the response (these samples are listed in Table 6-4 of the Revised Phase I RI Report). Of these 7, only 2 samples contained material that could reasonably be classified as lithopone. The remainder of the 7 samples was either residue or general fill. The actual composition of the other 16 samples could not be determined because we couldn't find any boring logs.*

*It appears that a distinction needs to be made in the text between lithopone and general fill/residue/other debris that have been disposed in the Lithopone Ridges Area. There are a lot of samples from the Lithopone Ridges Area that are primarily fill material and other site related waste, but little actual lithopone was sampled and tested. In general it appears uncertain whether the general fill and other waste material disposed in the area will generate acid, primarily because there were no other acid generating potential analyses for these samples to support the paste pH results. The actual acid generating capability of lithopone is unknown.*

**Review Response:** The "SS" samples listed in Table 6-4 of the Phase I RI report were collected in 1998 by Terra Environmental Services, Inc. as part of the Zinc Processing Waste and Demolition Debris and Supplemental Zinc Processing Waste Sampling and Analysis Programs. Representatives for Terra, ExxonMobil, Viacom, IEPA, and E&E were present during the sampling event and IEPA collected split samples. The results of this investigation were documented in an April 2002 Data Report, which did not contain boring logs for the "SS" soil samples. On behalf of IEPA, E&E prepared a May 1998 report entitled "Oversight Report – March 30-April 4, 1998 – DePue New Jersey Zinc/Mobil Chemical Site – DePue, Bureau Co., Illinois." Table 1 of the April 2002 Data Report provides a description of the sample designations as defined by the report authors, and brief sample descriptions are also included in Table 1 of the E&E Oversight Report. The designations provided by Terra were incorporated into Table 6-4 of the IEPA-approved Phase I RI report. It is not necessary to revise these previously agreed upon and approved classifications.

Based on the existing data, neither the general fill materials nor the lithopone materials in the Lithopone Ridges Area are acid generating. In addition, the acid-base accounting summarized for three Lithopone samples discussed in the response above (second bullet) indicate that the material is not acid producing. The paste pH results summarized in the Phase I RI will be incorporated into the revised report text.

**Comment 25.** Section 4.2.1.2, Native Material, page 35-36:

*f) Cation Exchange Capacity: Per Table 4-4, the average CEC for the peat was 29.9 meq/100g, not 23.9. The text should provide an interpretation of the data. A CEC of 29.9 meq/100g is low for a peat sample, indicating a relatively low capacity for metal sequestration.*

**Response:** The following text will be incorporated into the CEC discussion: "The CEC of the peat in the Lithopone Ridges Area is less than the CEC measured in the peat in other portions of the Site and is less than the CEC for typical organic soils. Therefore, the peat in the Lithopone Ridges Area has a lower capacity for metals sequestration than the peat located in other sections of the Site, but is two to four times greater than the CEC for the aquitard and aquifer samples indicating that the peat has a higher capacity for metals sequestration than the aquitard and the aquifer material in the Lithopone Ridges Area. The CEC of the aquitard material is within the typical range of CEC values for clays (3 to 150 meq/100g) and the CEC measured for the aquifer materials is within the low end of the range of typical CEC values for sand (3 to 20 meq/100g)."

**Illinois EPA Review:** *Response is not acceptable. The peat has a low capacity for sequestration as does the aquitard and aquifer, both of which are in the low range of typical CEC values for these materials. It's not significant that a peat with a low CEC value is still higher than aquitard and aquifer materials that have even lower CEC values. The point is that all three of these soils have a low CEC capacity and based on this line of evidence, a limited sequestration capability in the Lithopone Ridges Area. This should be the conclusion of this text.*

**Review Response:** As evidenced by the data, the CEC of the peat is greater than the CEC of the aquifer. The DePue Group agrees that the CEC measured of the three units in the Lithopone Ridges Area is low as compared to the other areas of the site, resulting in lesser sequestration capacity in the Lithopone Ridges Area.

The text will be revised as follows: "The CEC of the peat in the Lithopone Ridges Area is less than the CEC measured in the peat in other portions of the Site and is less than the CEC for typical organic soils (50 to 100 meq 100g<sup>-1</sup>) (refer to Footnote 1). Therefore, the peat in the Lithopone Ridges Area has a lower capacity for metals sequestration than the peat located in other sections of the Site. The CEC of the aquitard material in the Lithopone Ridges Area is within the low end of the



typical range of CEC values for clays (3 to 150 meq/100g) and the CEC measured for the aquifer materials is within the low end of the range of typical CEC values for sand (3 to 20 meq/100g). As a whole, the CEC results for the peat, aquitard, and aquifer samples obtained in the Lithopone Ridges Area are lower than in other areas of the site, indicating that these materials have less metal sequestration capacity in the Lithopone Ridges Area."

**Comment 26.** Section 4.2.2.1, Eastern Area Native Material, page 36:

a) *First paragraph: Per Table 4-3, three native material samples were obtained for paste pH and sulfur speciation. The text should explain why no Non-Native samples were collected for the Eastern Area.*

Response: The following text will be added to the report under Section 4.2.2: "An evaluation of the nonnative material at the FPSA was not completed in the Eastern Area as outlined in the IEPA-approved Phase II RI Work Plan. The evaluation of non-native material was completed in areas with greater amounts of non-native material, hence a greater potential for acid production (i.e., Slag Pile Area, UPSEA, and Lithopone Ridges Area). The following sections outline the native material testing in the Eastern Area."

**Illinois EPA Review:** *The lack of evaluation of non-native material from the Eastern Area for acid generating potential is a data gap.*

Review Response: During the Phase I RI, 14 non-native material samples were obtained for sulfur speciation and acid-base potential in the Eastern Area as outlined in the Data Report, and 72 non-native material samples were analyzed for paste pH as outlined in the Phase I RI. Therefore, this material was sufficiently evaluated and sampling of the non-native material in the Eastern Area was not considered a data gap in the Phase I RI or the Phase II RI Work Plan. The response and report text has been revised as follows: "An evaluation of the non-native material in the Eastern Area at the FPSA was not required in the IEPA-approved Phase II RI Work Plan because this material had previously been sufficiently evaluated and a data gap was not identified in the Phase I RI. A review of the information contained in the Phase I RI Data Report (Golder, 2002) indicates that 14 non-native samples as shown in Table C1-8 in Appendix V were obtained from the Eastern Area for sulfur speciation and acid generation potential during the Phase I RI in addition to the evaluation of non-native material that was completed during the CAMU Investigation performed as part of the Phase I RI activities. The results of the acid-base potential evaluation indicate that four of the 14 samples may be acid producing. Seventy-two paste pH samples were obtained from the non-native materials in the Eastern Area as outlined in Table 6-10 of the Phase I RI report. The paste pH of one of the 72 samples was less than 4.5 SU indicating the material would not produce acid. Based on the Phase I RI results, some of the non-native material present in the Eastern Area may produce acid in the future. The additional Phase II RI evaluations of non-native materials were focused on areas with greater amounts of non-native material, hence a greater potential for acid production (i.e., Slag Pile Area, UPSEA, and Lithopone Ridges Area). The following sections outline the native material testing in the Eastern Area."

A copy of Table C1-8 is included in Attachment 5.

d) Total Organic Carbon: *The text should provide an interpretation of the TOC concentration in terms of potential metals sequestration contributions for the two peat samples*

Response: The first sentence of text under the Total Organic Carbon heading will be revised as follows: "The TOC concentration for the two peat samples ranged from 24.8 percent to 32.6 percent,

which are high TOC values that are greater than the IEPA default value of 0.06 percent. Therefore, the TOC in the Peat in the Eastern Area likely increases the CEC of the peat."

**Illinois EPA Review:** *It should be noted that the two peat samples collected from the Eastern Area are actually a sample and its duplicate; therefore it is difficult to generalize about the TOC impact on CEC across the entire Eastern Area. Based on their depth of 5 to 9 feet bgs, a comparison to the TACO default value of 2,000 mg/kg is appropriate; this equates to 0.2 percent rather than 0.06 percent. The last sentence of the revised text would be better phrased as: "Therefore, the TOC in the Peat in the Eastern Area likely is the cause of the higher CEC value measured in the Peat."*

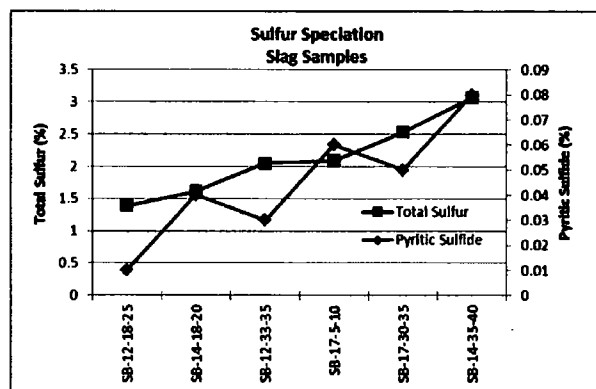
**Review Response:** The text will be revised as follows: "The TOC concentration for the two peat samples(sample and sample duplicate) ranged from 24.8 percent to 32.6 percent, which are high TOC values that are greater than the IEPA default value of 0.2 percent for soils below 1 meter of ground surface (subsurface soil). Therefore, the TOC in the Peat in the Eastern Area likely is the cause of the higher CEC value measured in the peat."

**Comment 27. Section 4.2.3.1, Slag Pile Non-Native Material, page 37-38:**

**b) Sulfur Speciation:** *The text should note that samples from boring SB14 in the center of the Slag Pile were collected above the depth interval where the highest Total Sulfur % was measured in a nearby borehole drilled in Phase 1 (see Figure 6-14, and log for W-8S, Phase 1 Report). This suggests that higher APP values, and potential acid generating conditions, may be found at in the center of the Slag Pile, below the 35-40 ft. interval sampled in boring SB14. It should be further noted in the text that the log for W-8S suggests that lithopone may have been encountered at 47-52 ft. within the Slag Pile.*

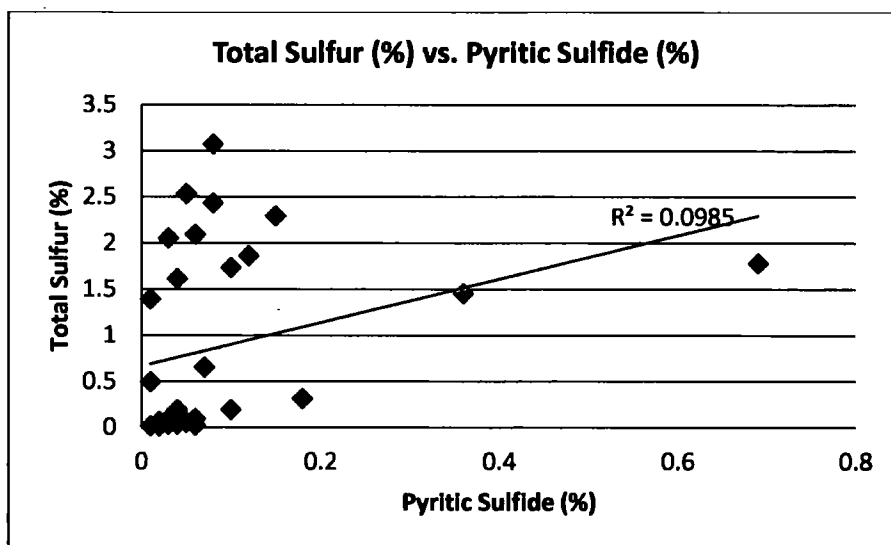
**Response:** The split sample obtained from 45 to 47 feet bgs at W-08(S) during the Phase I RI did contain total sulfur at 9.93%; however, the investigative sample obtained from 42.5 to 44 feet bgs contained total sulfur at 3.6%, which is close to the concentration of 3.07% measured from 35 to 40 feet bgs at SB-14. As shown on Table 4-3, a higher percentage of total sulfur in a sample does not necessarily correspond to a higher concentration of pyritic sulfide sulfur, which is the sulfur form of greatest concern for the acid-producing potential of a material. For example, the highest total sulfur concentration of 3.07% was measured in slag from 35 to 40 feet bgs at SB-14 located in the Slag Pile Area and the corresponding pyritic sulfide sulfur concentration was 0.08 %. In comparison, the highest pyritic sulfide concentration of 0.69 % was measured from peat material from 5 to 9 feet bgs at SB-08 (Eastern Area), which had a corresponding total sulfur concentration of 1.78%. Therefore, it should not be assumed that higher total sulfur concentrations equate to higher pyritic sulfide sulfur concentrations resulting in acid production. As discussed in Section 4.2.3.1, other lines of evidence including paste pH analysis and NAG testing indicate that the slag in the Slag Pile Area is net acid generating. Text will be added to Section 4.2.3.1 indicating that the boring log for Phase I RI boring for W-8S suggests that lithopone may have been encountered at 47-52 ft. within the Slag Pile.

**Illinois EPA Review:** *Response is not acceptable. Contrary to the response above, for the slag samples shown in Table 4-3 the percentage of total sulfur does correspond to a higher concentration of pyritic sulfide sulfur (see chart below). Therefore it is likely that higher acid producing potential may be found below 40 feet in the center of the Slag Pile. The text should be revised to address this.*



*Adding other text regarding lithopone in the Slag Pile is acceptable.*

**Review Response:** The chart presented in the IEPA review response is not correctly applied to an evaluation of data correlation. An evaluation of sample correlation would be better depicted by calculating the  $R^2$  value for all of the sulfur speciation results obtained during the Phase II RI. As shown in the graph below, there is no correlation between the total sulfur and pyritic sulfide data obtained during the Phase II RI.



Upon review of Table C1-8 of the Data Report (Golder, 2002), a sample and sample duplicate of the material from 50 to 53.7 feet bgs from W-08(S) with the highest total sulfur percent was also analyzed for pyritic sulfur, residual sulfur, and sulfur sulfate. A copy of Table C1-8 will be included in Appendix V of the revised Phase II RI and is included in Attachment 5. Pyritic sulfide sulfur, which is the sulfur form of greatest concern for the acid-producing potential of a material, was not detected from 50 to 53.7 feet bgs at W-08(S). As shown in Table C1-8, the acid-base potential or net neutralization potential was calculated conservatively using the total sulfur value to calculate the acid generation potential as 54J kg CaCO<sub>3</sub>/t and 71 kg CaCO<sub>3</sub>/t, indicating that this material is not acid generating. The text will be revised as follows:

"It should be noted that the sulfur speciation samples obtained from SB-14, located near the center of the slag pile, were not obtained from the depth interval (i.e., below 40 feet) that exhibited the highest concentration of total sulfur at nearby borehole W-08S during the Phase I RI. It should also be noted

that high levels of total sulfur does not necessarily indicate that the sample would have high levels of the acid-producing sulfur pyritic sulfide. Of the sulfur speciation samples collected in the Slag Pile Area, the highest percentage of the total sulfur is contributed from organic sulfur and sulfur sulfate rather than pyritic sulfide sulfur. Furthermore, it should also be noted that the boring log for Phase I RI monitoring well W-08(S) suggests that lithopone may have been encountered from 47 to 52 feet bgs within the Slag Pile; however, lithopone was not encountered at SB-13 and SB-14, indicating that this material is likely present only in the vicinity of W-08(S).

As outlined in Table C1-8 of the Data Report (Golder, 2002) and included in Appendix V, 17 slag and non-native material samples and two duplicate samples were analyzed for sulfur speciation and acid-base potential. Based on the total sulfur results, 10 samples could be acid producing and 7 samples would not. The results of the Phase I RI sulfur speciation and acid-base potential analysis are in general agreement with the Phase II RI data."

*d) Total Organic Carbon and Cation Exchange Capacity: The text should provide an interpretation of the TOC and CEC concentrations in terms of potential metals sequestration contributions for the slag samples. Results for both appear to suggest little sequestration capability.*

**Response:** The average TOC for the non-native material is greater than the default TOC of 0.06% for surface soils included in 35 IAC Part 742. The text for the CEC discussion will be revised as follows: "Six samples of the non-native material from the Slag Pile Area were analyzed for CEC. The results are summarized in Tables 4-3 and 4-4. As shown in Table 4-4, the CEC of the non-native material in the Slag Pile Area ranged from 10 meq/100g to 19 meq/100g with an average of 14 meq/100g, which is within the typical CEC range for sand. The CEC results from the non-native materials in the Slag Pile Area are similar to the CEC results from non-native material samples in the Lithopone Ridges Area and the UPSEA. Based on the average CEC value, the CEC of the non-native material from the Slag Pile Area appears to have little effect on the sequestration capability of the non-native material."

**Illinois EPA Review:** *Based on the depths of the non-native Slag Pile Area samples (they are not surface soils), a comparison to the TACO default value of 2,000 mg/kg is appropriate; this equates to 0.2 percent. The final sentence of the revision should be revised as such: "Based on the average CEC value, the CEC of the non-native material from the Slag Pile Area appears to have little sequestration capability."*

**Review Response:** The data indicates that the average TOC for the non-native material is much greater than the IEPA default TOC of 0.2% for soil below one meter (subsurface soils). The CEC report text will be revised as follows: "Six samples of the non-native material from the Slag Pile Area were analyzed for CEC. The results are summarized in Tables 4-3 and 4-4. As shown in Table 4-4, the CEC of the non-native material in the Slag Pile Area ranged from 10 meq/100g to 19 meq/100g with an average of 14 meq/100g, which is within the typical CEC range for sand. The CEC results from the non-native materials in the Slag Pile Area are similar to the CEC results from non-native material samples in the Lithopone Ridges Area and the UPSEA. Based on the average CEC value, the CEC of the non-native material from the Slag Pile Area appears to have a low sequestration capability. Based on the low CEC of the non-native materials in the Slag Pile Area, it does not appear that the high TOC measured in these materials enhances the CEC."

**Comment 28.** Section 4.2.3.2, Slag Pile Native Material, page 39:

*b) NAG Testing: Per Table 4-3, only one aquifer and one peat sample underwent NAG testing.*

**Response:** The existing text states one aquifer and one peat sample underwent NAG testing. Text revisions are not required.

**Illinois EPA Review:** The first paragraph of text in this section states three aquifer samples and one peat sample underwent NAG testing; the NAG Testing text indicates one aquifer sample and one peat sample. A revision should correct the inconsistency.

**Review Response:** The text in Section 4.2.3.2 will be revised as follows: "To evaluate the potential of the native material in the Slag Pile Area to generate acid, three samples of the aquifer and one sample of the peat were analyzed for paste pH and sulfur speciation and one aquifer and one peat sample underwent NAG testing."

**Comment 31.** Section 4.2.5, Sequential Batch Testing, page 42-44:

b) The end of this section needs a summary that provides a more comprehensive interpretation of the results. There appear to be differences in the sequestration capacity of tested soils depending on where they were collected; some of the soils tested appear to have metals leached from them; when sequestration is indicated by the test results, the data also suggests that the sequestration capacity is quickly exhausted (concentrations in the 10 day supernatant are 60% to 99% of the original source water concentrations); there is a difference in the soil materials tested as aquitard materials (AQTD1 is organic clay, AQTD2 is sandy silt); there should be an interpretation of these results as they pertain to the distribution of metals found in the UWBZ and Lower Aquifer, and Slag Pile vs. Lithopone Area.

	Peat 1		Peat 2		AQTD 1		AQTD 2		AQ 1 (SI SND)		AQ 2 (SI SND)	
Aluminum	SEQ		?		SEQ		LEACHABLE		LEACHABLE		LEACHABLE	
Arsenic	ND		NONE		ND		LEACHABLE		LEACHABLE		NONE	
Barium	?		?		ND		LEACHABLE		LEACHABLE		LEACHABLE	
Beryllium	?		?		ND		LEACHABLE		?		NONE	
Cadmium	SEQ		SEQ		SEQ	E	SEQ	E	SEQ	E	SEQ	
Chromium	?		?		ND		LEACHABLE		LEACHABLE		NONE	
Cobalt	SEQ	E	?		SEQ	E	LEACHABLE		NONE		NONE	
Copper	SEQ		?		SEQ		LEACHABLE		SEQ		LEACHABLE	
Iron	SEQ		?		SEQ		LEACHABLE		LEACHABLE		LEACHABLE	
Lead	SEQ		?		SEQ		LEACHABLE		SEQ		NONE	
Manganese	SEQ	E	SEQ		SEQ	E	LEACHABLE		LEACHABLE		SEQ	E
Mercury	ND		ND		ND		ND		ND		ND	
Nickel	SEQ	E	ND		SEQ	E	LEACHABLE		NONE		NONE	
Selenium	ND		ND		ND		ND		NONE		ND	
Silver	ND		ND		ND		ND		NONE		ND	
Thallium	ND		ND		ND		ND		NONE		ND	
Vanadium	?		?		ND		LEACHABLE		LEACHABLE		LEACHABLE	
Zinc	SEQ	E	SEQ		SEQ	E	SEQ	E	SEQ		SEQ	E

SEQ = Sequestered

LEACHABLE = Possibly Leached but Metal not Observed in Supernatant Water at Elevated Levels above Source water

ND = Nondetect

NONE = No Significant Sequestration Effect

? = Metal NonDetect in Source Water but Final Soil Concentration Increased

E = Sequestration Capacity Nearly Exhausted after 10 days

PEAT 1, AQTD 1, and AQ 1 = composite samples from south side of Slag Pile Area

PEAT 2, AQTD 2, and AQ 2 = composite samples from south side of Lithopone Area

**Response:** The text will be revised to include the following discussion and table:

"It is true that for certain metals when sequestration is indicated by the test results, the data also suggest that the sequestration capacity is quickly exhausted (concentrations in the 10 day supernatant are 60% to 99% of the original source water concentrations). However, it should also be noted that for certain metals when leachability is indicated by the test results, a corresponding increase in the metals concentrations in the supernatant is not observed.

Based on the results of the sequential batch testing and the observed metals concentrations in the UWBZ and the Lower Aquifer, the Aquitard material (Peat and Silty Clay) in general is sequestering metals (see Table below), resulting in decreased metals concentrations in the Lower Aquifer groundwater as compared to the metals concentrations in the UWBZ groundwater. The sequential batch test results for the Lower Aquifer material (Sands) are expected based on the affinity of sand surfaces for metals."

In general, the Aquitard material (Peat 1 and Silty Clay 1) in the Slag Pile area exhibits a greater ability to sequester metals than the Aquitard material (Peat 2 and Silty Clay 2) in the Lithopone Ridges area (see Table below)."

***Illinois EPA Review:*** The table below should be reviewed again to check for consistency with the definitions provided in the footnote. Revisions have been indicated on the table.

*The sequential batch test results for the Lower Aquifer are unexpected because cationic metals do not typically have an affinity for sand surfaces. Adsorption of metal cations is more often correlated with soil properties such as pH, redox potential, clay mineral content, soil organic matter, iron and manganese oxides, and calcium carbonate content. None of these are discussed. Any apparent "sequestration" exhibited by the Lower Aquifer material sands may be due to adsorption to Fe and Mn oxides (source water for AQ1a and AQ 1b had much higher concentrations of Fe and Mn than source water for AQ2) formed during the experiment, instead of an affinity to the surface of sand particles. This portion of the response must be corrected and revised.*

	AQUITARD MATERIAL								LOWER AQUIFER MATERIAL					
	Peat 1		Peat 2		Silty Clay 1		Silty Clay 2		AQ 1a (SI SND)		AQ 1b (SI SG)		AQ 2 (SI SND)	
Aluminum	SEQ		ND		SEQ		LEACHABLE		LEACHABLE		SEQ		LEACHABLE	
Arsenic	ND		ND		ND		ND		ND		ND		ND	
Barium	ND		ND		ND		LEACHABLE		LEACHABLE		LEACHABLE		LEACHABLE	
Beryllium	ND		ND		ND		LEACHABLE		ND		ND		ND	
Cadmium	SEQ		SEQ		SEQ	E	SEQ	E	SEQ	E	SEQ		SEQ	
Chromium	ND		ND		ND		LEACHABLE		ND		ND		ND	
Cobalt	SEQ	E	ND		SEQ	E	ND		NONE		SEQ	E	ND	
Copper	SEQ		SEQ		SEQ		LEACHABLE		SEQ		SEQ		LEACHABLE	
Iron	SEQ		ND		SEQ		LEACHABLE		LEACHABLE		SEQ		LEACHABLE	
Lead	SEQ		LEACHABLE		SEQ		LEACHABLE		SEQ		SEQ		NONE	
Manganese	SEQ	E	SEQ		SEQ	E	LEACHABLE		LEACHABLE		SEQ	E	SEQ	E
Mercury	ND		ND		ND		ND		ND		ND		ND	
Nickel	SEQ	E	ND		SEQ	E	LEACHABLE		NONE		SEQ	E	LEACHABLE	
Selenium	ND		ND		ND		ND		ND		ND		ND	
Silver	ND		ND		ND		ND		ND		ND		ND	
Thallium	ND		ND		ND		ND		ND		ND		ND	
Vanadium	ND		ND		ND		LEACHABLE		LEACHABLE		LEACHABLE		LEACHABLE	
Zinc	SEQ	E	SEQ		SEQ	E	SEQ	E	SEQ	E	SEQ	E	SEQ	E

SEQ= Sequestered

LEACHABLE= Possibly Leached but Metal not Observed in Supernatant Water at Elevated Levels above Source water

ND= Nondetect/essentially non-detect in source water and sequestered metals observed in soil

NONE= No Significant Sequestration Effect

E= Sequestration Capacity Nearly Exhausted after 10 days

PEAT 1, Silty Clay 1, and AQ 1a, 1b = composite samples from south side of Slag Pile Area

PEAT 2, Silty Clay 2, and AQ 2= composite samples from south side of Lithopone Area



**Review Response:** The table contained in the Illinois EPA review has been altered from the table contained in the original Illinois EPA comment and the initial ENVIRON response. With the exception of nickel for AQ2, the DePue Group is in agreement with the table above. Nickel should be classified as "None" for two reasons: (1) it was not detected in the supernatant water and (2) the original and the final soil concentrations only differed by 2 mg/kg; therefore, there was no significant sequestration or leaching effect for nickel for the AQ2 material. The table, with the revision for nickel for sample AQ2, will be incorporated into the revised report as Table 4-5B.

The second paragraph of the text addition proposed in the initial ENVIRON response above will be revised as follows:

"Based on the results of the sequential batch testing and the observed metals concentrations in the UWBZ and the Lower Aquifer, the Aquitard material (Peat and Silty Clay) in general is sequestering metals (see Table 4-5B), resulting in decreased metals concentrations in the Lower Aquifer groundwater as compared to the metals concentrations in the UWBZ groundwater. The apparent sequestration exhibited by the Lower Aquifer material sands during the sequential batch test may be due to adsorption to iron and manganese oxides formed during the experiment."

*g) Arsenic, beryllium, chromium, cobalt, copper, and nickel also appear to be leached from the aquitard soil from SB-8 and SB-31.*

**Response:** Based on a review of the data, ENVIRON disagrees with IEPA's comment "Arsenic, beryllium, chromium, cobalt, copper, and nickel also appear to be leached from the aquitard soil from SB-9 and SB-31." The changes in concentration from the original soil to the final soil for these metals are within the range of sample and laboratory variability and are not indicative of the metals being leached from the soil.

**Illinois EPA Review:** The QAPP control limit for duplicate soil variability is a Relative Percent Difference of 35%. The RPD is an indicator of acceptable laboratory variability and it was applied to here to see if the original and final soil would fall in the acceptable range for sample or laboratory variability. The table below shows the RPD for copper and beryllium from aquitard soil AQ2 (SB-8 and SB-31). The RPD for beryllium and copper exceed 35% indicating that the differences between the Original Soil and the Final Soil are not solely due to laboratory variability. The change in concentration is indicative of metals being leached from the soil. The text should be revised to include beryllium and copper to the list of metals (Mn, Ba, Fe, Pb, Vn) that may have been leached from the aquitard material during the batch test.

**AQ 2 Soil , Silty Clay**

	Original Soil (mg/kg)	Final Soil (mg/kg)	Relative Percent Difference
Be	0.51	0.07	38
Cu	13.7	2.3	36

$$RPD = \frac{|S - D|}{(S + D)/2} \times 100$$

where : S= Original Soil  
D= Final Soil

**Review Response:** The text in the "SB-8 and SB-31 Aquitard" paragraph of Section 4.2.5 will be changed to read: "The final soil concentration of aluminum, barium, beryllium, copper, iron, lead, and vanadium are less than the original soil concentration indicating that these metals may have been leached from the aquitard material during the batch test. However, these metals were not detected in the supernatant at concentrations greater than the source water."

**Comment 35.** *Section 4.6.3, Hydraulic Properties, pages 46-48:*

*a) A contour map depicting the hydraulic conductivity of the aquitard should be generated from the flexible wall permeameter measurements provided in Table 4-9 so that the spatial distribution of hydraulic conductivities can be observed across the site. The figure should also depict areas where the aquitard is absent.*

**Response:** The vertical hydraulic conductivity data for the aquitard collected during the Phase I and Phase II RI's provide information regarding the range of vertical hydraulic conductivity throughout the FPSA at the locations tested. As shown in Table 4-9, the vertical hydraulic conductivity of the aquitard is highly variable and ranges from approximately  $10^{-5}$  to  $10^{-8}$  centimeters per second. Order of magnitude variability in vertical hydraulic conductivity has been observed within both short and long distances. Contouring these data would not necessarily provide an accurate depiction of the vertical aquitard conductivity at the site.

**Illinois EPA Review:** *In a dynamic depositional area such as the FPSA, one could expect to observe order of magnitude variability in vertical hydraulic conductivity within both short and long distances. The development of a contour map to show the spatial distribution of hydraulic conductivities across the site is a better tool to locate areas where potential contaminant migration may occur, as well as to show areas where the aquitard is absent (which is poorly depicted in the current Phase II RI Report figures). The example provided below is only one method of depicting conductivity contours. By employing the contour map one can observe potential patterns of higher conductivity (e.g.,  $> 1E-5$  cm/s) coupled with missing portions of the aquitard, and begin to make an interpretation of the local variability. Areas of higher conductivity potentially can facilitate greater transport across the aquitard (obviously including areas where the aquitard is absent), and it is*



*important to locate and interpret the significance of these areas as part of the RI.*



Review Response: As outlined in the original response to comments, the DePue Group does not consider the contouring the aquifer hydraulic conductivity as shown in the IEPA example above provides an accurate depiction of the vertical aquitard conductivity at the site because order of magnitude variability in vertical hydraulic conductivity has been observed within both short and long distances. The materials were deposited in an alluvial environment, which can be highly variable. Rather than contouring the vertical hydraulic conductivity data of the aquitard, Figure 4-12B in Attachment 1 provides a visual interpretation of the vertical hydraulic conductivity data on a site map with color-coded circles depicting order of magnitude of vertical hydraulic conductivities of the aquitard at the locations where measurements were taken and also shows the approximate areas of the Site where the aquitard is absent.

*b) The text states that the aquitard permeability is approximately four orders of magnitude less than that of the materials in the UWBZ. This is not always the case, particularly where the aquitard has larger permeabilities (in the  $1 \times 10^{-5}$  range). In some areas the difference between the UWBZ and the aquitard may be less than 2 orders of magnitude. The text should be revised and should include a discussion of the variability found in the aquitard across the site, and how this may, or may not, effect the potential for vertical migration of contaminants. Areas where the aquitard is not present or not competent should also be identified and discussed.*

Response: Additional text will be added as follows: "As shown in Table 4-9, the areas of the lowest vertical Aquitard hydraulic conductivity are located at SB-01/MW-20B located in the southwest corner of the site (Western Area); SB-10/MW-24U located in the southern extent of the Eastern Area; B-4, SB-30/MW-30T, SB-28/MW-41U, SB-29, W-20(I), and SB-32 in the Lithopone Ridges Area; PZ01(I) on the northwest corner of the Slag Pile and J10 and J11 south and southeast of the Slag Pile; and L3 and SB-37/MW-36T in the UPSEA. Areas of higher vertical hydraulic conductivities in the range of  $10^{-5}$  to  $10^{-6}$  cm/sec are located at SB-6 in the western portion of the Eastern Area and SB-7 in the central portion of the Eastern Area; SB-4 at the eastern extent of the Western Area; PZ-04(I) and J8 in the southwest corner of the Slag Pile and PZ-02(I) northeast of the Slag Pile, and SB-23/MW-27T,

W-18(D), and SB-24/MW-28T at the southern extent of the UPSEA. The Aquitard is not present in the southwest corner of the Slag Pile Area at J7, SB-11, and SB38/MW-37U and in the Vanadium Pentoxide Catalyst Disposal Area. Based on this information, the areas of the greatest potential for vertical migration of COPCs through the Aquitard and into the Lower Aquifer are in the vicinity of the southwest corner of the Slag Pile Area where the Aquitard is not present and areas where higher vertical hydraulic conductivities were measured in the Aquitard, such as the northern portion of the Slag Pile Area, the southern portion of the UPSEA, and the western and central portions of the Eastern Area."

**Illinois EPA Review:** *This detailed text revision could be and should be easily replaced or supplemented by a contour map to show the spatial distribution of hydraulic conductivities and absence of aquitard across the site [refer to review of response to comment 35a) above].*

**Review Response:** See response to comment 35a above and Figure 4-12B in Attachment 1. A contour map is not an accurate representation of hydraulic conductivities but instead oversimplifies the Site conditions. Figure 4-12B will be added, and the text revision proposed in the initial response will be kept with the exception that the first part of the first sentence will be revised as follows: "As shown in Table 4-9 and Figure 4-12B,..."

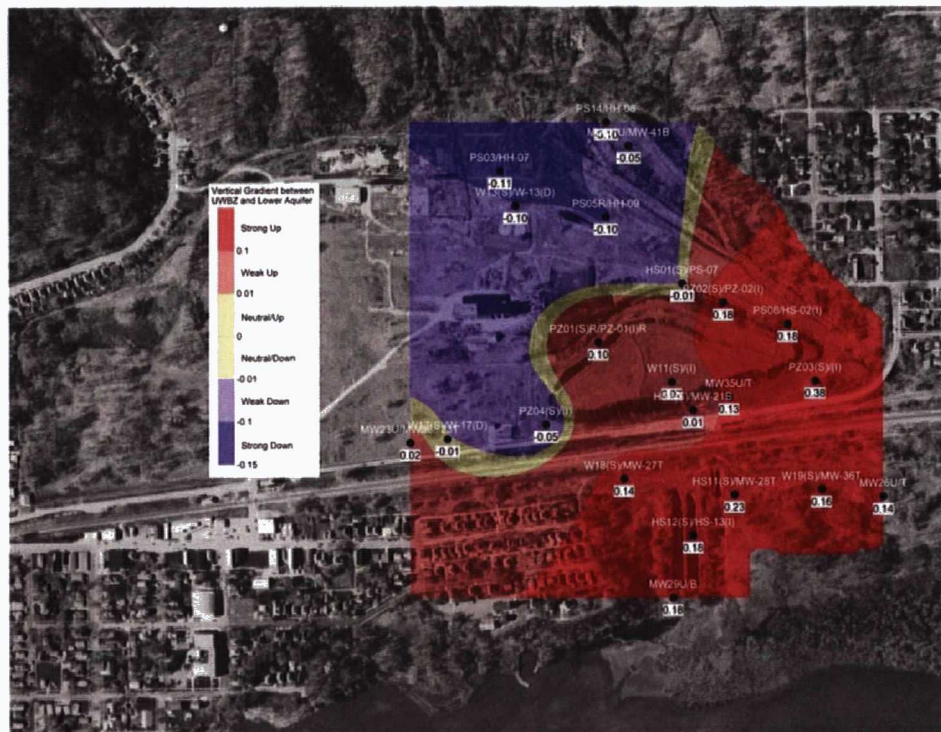
**Comment 36.** Section 4.6.4.2, Groundwater Gradients, page 48-49:

*d) Two contour maps should be prepared: one mapping the vertical gradients measured between the UWBZ and the TOLA, and the second mapping the vertical gradient within the Lower Aquifer, i.e., between the TOLA and the BOLA. There appear to be areas where the downward direction of the vertical gradient between the UWBZ and the TOLA is matched by a similar downward direction gradient within the Lower Aquifer. These could be areas where, in the absence of geochemical or lithologic controls, vertical migration of contaminants from the UWBZ to the TOLA may occur. Still other areas have coincident upward gradients within and between the two units. A third condition appears to exist in the vicinity of the Slag Pile and the UPSEA south of the Slag Pile, where the gradient between the UWBZ and the TOLA is upward, but at the same location the gradient within the Lower Aquifer between the TOLA and BOLA is downward. This should be discussed and interpreted in the text.*

**Response:** It is ENVIRON's opinion that maps depicting vertical hydraulic gradients are not needed to understand site conditions. Additional interpretation of the vertical gradients will be provided in the revised text.

**Illinois EPA Review:** *The development of a contour map to show the spatial distribution of vertical gradients between the UWBZ/TOLA and the TOLA/ BOLA across the site is a better tool than another text revision.*





**Review Response:** As requested by IEPA, Figure 4-53 (Attachment 1) has been prepared to contour the vertical hydraulic gradient between the UWBZ and the Lower Aquifer. Except for the vertical gradient between HH-07 and W-13(D) in the Eastern Area with an approximate -0.2 foot vertical gradient and MW-36T and W-19(D) in the UPSEA with an approximate +0.1 vertical gradient, the average vertical gradients between the TOLA and the BOLA are slightly downward or slightly upward. Because of the lack of differences beyond a few tenths of a foot in the vertical gradients between the TOLA and the BOLA, a contour map of the vertical gradients between the TOLA and BOLA was not considered appropriate and therefore was not prepared.

*e) On Table 4-11, there are ten well pairs located south of Marquette St. where the vertical gradient within the Lower Aquifer (BOLA/TOLA) was calculated. At these ten well pair locations a downward vertical gradient is measured in seven. Given what we know about the absence of the Lower Aquifer south of the lake (in the DSDA), and the fact that most of the Lower Aquifer well pairs demonstrate a downward gradient not indicative of significant discharge to the shallow lake, the last paragraph of this section requires a more detailed interpretation.*

**Response:** Upon further review of Table 4-11, the vertical gradient calculations for HS-13(I) and MW-29B (TOLA/BOLA) have been removed from consideration as the two wells are approximately 350 feet apart and the lower aquifer at MW-29U/B was not thick enough to install both a TOLA and BOLA well. Of the now nine well pairs south of Marquette Street referenced by IEPA, three well pairs show a downward vertical gradient (i.e., MW-46T/B, MW-27D/W-18(D), and MW-25T/B); three show a neutral vertical gradient (i.e., MW-26T/B, MW-44T/B, and MW-47T/B); three show an upward vertical gradient (MW-36T/W-19(D), MW-50T/B, and MW-48T/B). The vertical gradient between the UWBZ and the Lower Aquifer provides more information regarding potential discharge to the Lake. As shown on Table 4-11, upward vertical gradients are present at all six UWBZ/Lower Aquifer well pairs in the UPSEA and artesian conditions are present at off-site well MW-45B, located in Lake Park, MW-49B (east of the UPSEA), and MW-25T/B located in the northeast corner of the UPSEA. Furthermore, the Lower Aquifer groundwater elevations measured in the monitoring wells adjacent to

the Lake are greater than the elevation of the bottom of DePue Lake (i.e., DePue Lake bottom is less than 450 feet amsl). Lastly, based on the soil borings advanced on the peninsula between DePue Lake and the Illinois River as part of OU2 investigation activities, the Lower Aquifer does not continue southward beyond the lake, consequently, groundwater discharges from the Lower Aquifer to stream channels, springs, seeps, wetland soils surrounding the Lake, and possibly through the lake bed. Discharge through the wetland soils and, if the Lower Aquifer extends beyond the Lake, through lake bed sediments, occurs by upward diffuse flow through soils and sediments driven by an upward hydraulic gradient.

**Illinois EPA Review:** *It is unclear from the response what revision will be applied to the text. If the intention is to use the proposed OU2 report conclusion (i.e., discharge to stream channel, springs, seeps and wetland soils), it should be acknowledged in the OU3 report revision that this proposed conclusion is still under investigation.*

**Review Response:** The results of the soil borings drilled on the peninsula south of Lake DePue in May 2012 and the groundwater data from the N series seeps confirm the conclusions of groundwater discharge from the Lower Aquifer; therefore, reference the OU2 investigations will not be referenced. The following text will be added to the end of the second paragraph under the "Vertical Gradients" subsection of 4.6.4.2: "The upward vertical hydraulic gradient observed at MW-48T/MW-48B indicates that the FPSA Water Intake structure may be a discharge point for the Lower Aquifer during non-flood stages because of the upward vertical gradient at MW-48T/B measured during non-flood events (Table 4-11) and the groundwater flow direction in the Lower Aquifer, which is toward this location as observed on Figure 4-41 and others. Furthermore, the Lower Aquifer groundwater elevations measured in the monitoring wells adjacent to the Lake are greater than the elevation of the bottom of DePue Lake (i.e., DePue Lake bottom is less than 450 feet amsl) and the DePue Lake/Illinois River surface water elevation. Lastly, based on the soil borings advanced on the peninsula between DePue Lake and the Illinois River as part of OU2 investigation activities, the Lower Aquifer does not continue southward beyond the lake, consequently, groundwater discharges from the Lower Aquifer to stream channels, springs, seeps, wetland soils surrounding the Lake, and possibly through the lake bed."

*f) Although water levels in the TOLA/ BOLA wells monitored with transducers appear to fluctuate with either precipitation or lake/river levels (Appendix I), the lake apparently doesn't recharge the Lower Aquifer when at flood stage, except possibly at location MW-48T, where the lake flood stage and groundwater elevations essentially match. Given that this is a unique occurrence for TOLA/BOLA wells installed along the lake shore, Illinois EPA suspects the FPSA Water Intake structure may provide a direct connection between the lake and aquifer. This may also be a consistent discharge point for the Lower Aquifer during non-flood stages. Further evidence for this is the upward vertical gradient at MW-48T/B measured during non-flood events (Table 4-11) and the groundwater flow direction in the Lower Aquifer is toward this location as observed on Figure 4-41 and others*

**Response:** Noted

**Illinois EPA Review:** *The detailed interpretation requested in comment 36e) regarding groundwater gradients should include some reference to the points in agency comment 36f)*

**Review Response:** See review response to Illinois EPA Review to comment 36e.

**Comment 38.** Section 4.7.1 IRM Wall Technology Description, page 50: *It should be noted that the guidance document USEPA 1998 describes sulfate reduction in permeable reactive barriers as primarily mediated by sulfate-reducing bacteria. Typically a source of carbon is introduced with the iron-rich material to stimulate the growth of these bacteria. Based on our current knowledge, a*

*carbon source was not part of the construction of the IRM walls at the DePue site. The IRM walls appear to have no impact on sulfate concentrations. The last sentence of this section should be omitted.*

**Response:** The last sentence of Section 4.7.1 will be revised as follows: "IRM, which has been supplemented with a carbon source, is also effective at sulfate reduction (USEPA, 1998)."

**Illinois EPA Review:** *Because Section 4.7.1 is a general description of IRM Wall technology, this revision is acceptable; however, the discussion of the site-specific IRM Wall should state that a carbon source was not known to be included in the construction.*

**Review Response:** The last sentence of Section 4.7.1 will be revised as follows: "IRM, which has been supplemented with a carbon source, is also effective at sulfate reduction (USEPA, 1998); however, it is unknown if a carbon source was added to the IRM material placed at the Site."

**Comment 39.** *Section 4.6.4.5, Shoreline Seeps, page 50: The elevation of the shoreline seeps should be provided in Table 4-12, and some interpretation of the data in this table should be provided. What was learned by measuring the distance from the seep to the lake edge during bi-weekly visits? Do seeps fluctuate as lake levels rise and fall?*

**Response:** The elevations of the shoreline seeps will be added to Table 4-12.

The following discussion will be added to Section 4.6.4.5: "As discussed in the Groundwater Investigation Technical Memorandum, Revision 1, the purpose of the seep monitoring was to evaluate the source of the seep water. Three possible sources of the seep water were identified: (1) groundwater migrating from the FPSA and discharging at the seeps; (2) rainwater infiltrating through soils and discharging at the seeps; or (3) as the lake level rises during high-water events, lake water flowing back into soils at the shoreline then gradually discharging back to the lake. As shown in Table 4-12, the monitored seeps were observed to be flowing throughout the monitoring period except when the seeps were flooded by DePue Lake. The relative sizes of many of the seeps generally remained the same throughout the monitoring period, which indicates that groundwater migration is a significant source of these seeps. It is likely that rainwater and elevated lake levels contribute to the seeps during times of heavy rain or high lake levels, but because the seeps are a consistent size, groundwater is likely the dominant source of these seeps. The size of other seeps (i.e., SP-03, SP-08, and SP-10) varied throughout the monitoring period. The variability in the size of these seeps indicates that they are likely influenced by rainfall."

Based on a visual review of the data, the size of the seeps does not appear to be correlated to the lake level.

**Illinois EPA Review:** *When elevations are added to Table 4-12 they should be the actual elevation where the seep most consistently exits the ground surface. This may not necessarily be the point at which the seep has been routinely sampled. The concern is that in some instances the sampling point may be a lower elevation downstream of the actual head of the seep. The response does not address what was learned by measuring the distance from the seep to the lake edge; this should be included in the text revision.*

**Review Response:** The seep elevations added to Table 4-12 were obtained at the actual elevation where the seep exited the ground at the time of surveying and is the point at which the seeps were routinely sampled. When the seep data were evaluated, no additional conclusions were drawn based on the distance of the seep to the lake edge; therefore, no text edits are proposed. Table 4-12 is included in Attachment 6.



**Comment 41.** Section 4.7.5, Groundwater Flow Evaluation Results, pages 53-54, Table 4-16:

c) The final paragraph of this section is confusing. It would appear that the text should state: To calculate the estimated percentage of groundwater volume flowing between HS-3(S) and TW-5U that was captured by the IRM Wall/Interceptor Trench System on November 15, 2010 and September 14, 2010, the inflow to the IWTP on these dates (13,271 and 9,825, respectively) was divided by the maximum groundwater flux (or volume flowing between HS-3(S) and TW-5U) on those dates (15,358 and 17,604 gallons, respectively).

Response: Noted.

**Illinois EPA Review:** It's not clear what the response "noted" means. Does the DePue Group accept the suggested text revision?

Review Response: Noted means that the suggested text revision is accepted. The text will be revised as follows: "To calculate the estimated percentage of groundwater flux across the southern property boundary between HS-03(S) and TW-5S that is captured by the IRM Wall/Interceptor Trench System during baseline conditions on November 15, 2010 and September 14, 2010, the inflow to the IWTP on these dates (13,271 gallons and 9,825 gallons, respectively) was divided by the estimated maximum groundwater flux on these dates (15,358 gallons and 17,604 gallons, respectively). As shown on Table 4-16, the percentage of the maximum groundwater flux captured by the IRM Wall/Interceptor Trench was approximately 86% on November 15, 2010 and 56% on September 14, 2010".

e) On Table 4-16, the volume of IWTP inflow from the IRM Wall/Interceptor System for the dates 7/19/10, 2/14/11, and 5/16/11 (74,548 gal/day., 32,881 gal/day. and 39,372 gal/day respectively) far exceeds the maximum groundwater flux between HS-3(S) and TW-5U on the same dates (18,726 gal/day, 11,975 gal/day, and 16,440 gal/day respectively). What is the source of the extra water?

Response: As outlined in the text and table, the additional water on those dates is a result of precipitation and snowmelt.

**Illinois EPA Review:** On further review there are a couple issues with the text of Section 4.7.5 and with Table 4-15 and 4-16:

- In the text and in Table 4-15 the units for discharge per unit width of aquifer should be  $\text{ft}^3/\text{d}$ , not  $\text{ft}^2/\text{d}$ .
- On Table 4-16 the column header "Seepage Velocity ( $\text{ft}^2/\text{d}$ )" is incorrect. The Min. Max, and Geomean values in these columns are the discharge (flux) through a unit width of the UWBZ in units of  $\text{ft}^3/\text{d}$ .

Review Response: The IEPA's review is not correct. The unit of discharge per unit width of aquifer is  $(\text{ft}^3/\text{day})/\text{ft}$ , which equates to  $\text{ft}^2/\text{day}$ . The column header will be changed to "Discharge per Unit Width ( $\text{ft}^2/\text{day}$ )".

f) The discussion in this section should include a calculation of the flux below the full length of the Slag Pile. Since all of this water is potentially impacted by the Slag Pile, approximately what percentage of this flux does the IRM System capture?

Response: Table 4-16 will be revised to include groundwater flux estimates between PZ-04(S)R and PZ-03(S) along the east-west length of the slag pile. The following paragraph will be added to Section 4.7.5: "To calculate the estimated percentage of groundwater flux across the southern

property boundary along the entire east-west length of the Slag Pile from PZ-04(S)R to PZ-03(S) that is captured by the IRM Wall/Interceptor Trench System during baseline conditions on November 15, 2010 and September 14, 2010, the inflow to the IWTP on these dates (13,271 gallons and 9,825 gallons, respectively) was divided by the estimated groundwater flux on these dates between PZ-04(S)R and PZ-03(S) (52,300 gallons and 60,060 gallons, respectively). As shown in Table 4-16, the percentage of the maximum groundwater flux captured by the IRM Wall/Interceptor Trench was approximately 25% on November 15, 2010 and 16% on September 14, 2020."

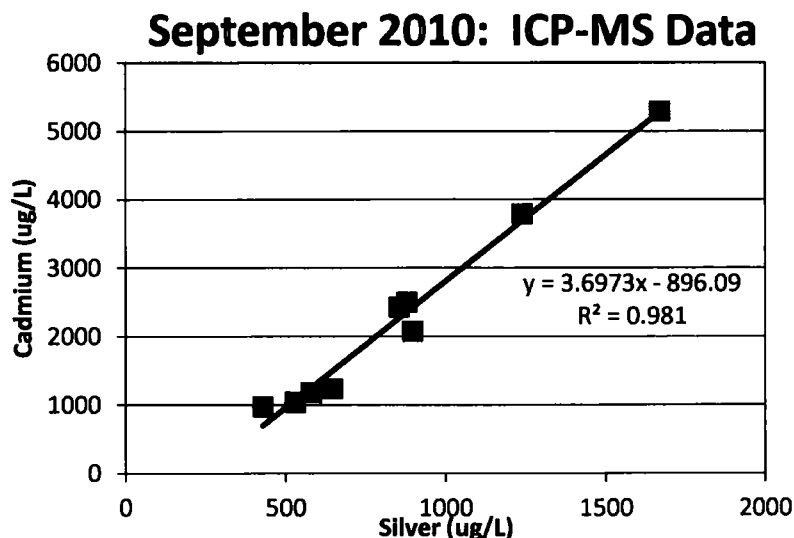
**Illinois EPA Review:** Response is acceptable. The year was 2010, not 2020 for the reference to September 14.

**Review Response:** The last sentence will be edited as follows: "As shown in Table 4-16, the percentage of the maximum groundwater flux captured by the IRM Wall/Interceptor Trench was approximately 25% on November 15, 2010 and 16% on September 14, 2010." Table 4-16 is included in Attachment 6.

**Comment 42.** Section 4.7.6, IRM Wall/Shallow Interceptor Trench System Sampling Results, pages 54-57, Table 4-16, and Appendix L:

a) If the reason for the elevated September 2010 silver results was due to the use of the ICP/MS method instead of the ICP method, it is unclear why all of the September 2010 silver detections would not be elevated as well. Silver was detected in September 2010 at TW-3U and HS-09(S), but only at 10.9 and 6.8 J ug/L, respectively.

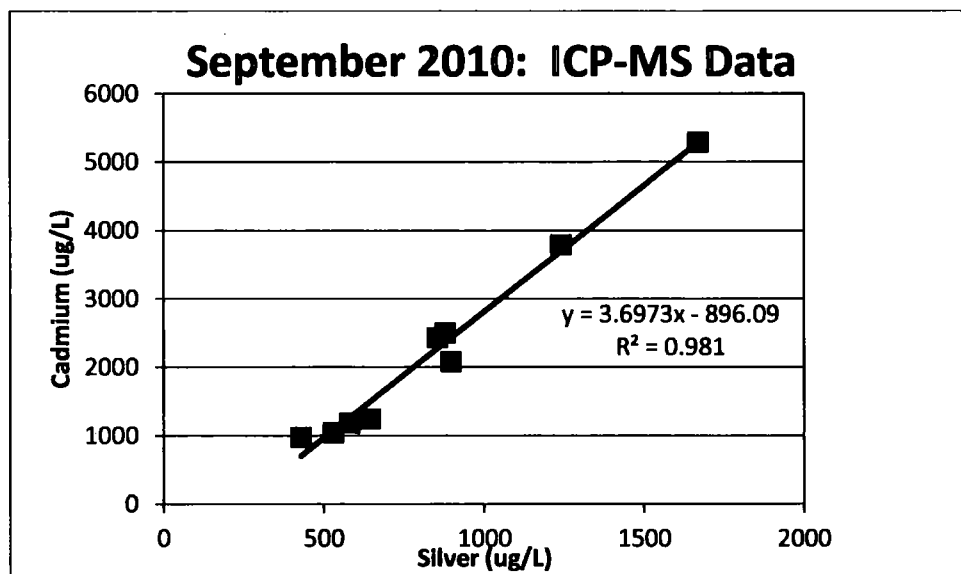
**Response:** Based on the data, the elevated ICP-MS September 2010 silver results show correlation with the cadmium concentrations (see figure below). Only those samples with elevated cadmium concentrations had elevated silver concentrations. When the ICP-AES method was used for the October 2010 analyses, the silver concentrations were either at low levels or not-detected, which is consistent with historical trends.



**Illinois EPA Review:** These correlations should be included in the revised report text.

**Review Response:** The report text will be revised as follows:

**"Silver:** The laboratory analyzed the groundwater samples obtained during the September 2010 sampling event prior to trench shutdown for silver using the ICP/MS method instead of the ICP method that was used during the other groundwater sampling events at the site. The laboratory results using the ICP/MS method were elevated from the other sampling events and are not consistent with concentrations measured historically at the permanent monitoring wells that were used in the monitoring well transects (i.e., when the ICP-AES method was used for the October 2010 analyses, the silver concentrations were either at low levels or not-detected, which is consistent with historical trends). In addition, based on the data, the elevated ICP/MS September 2010 silver results show correlation with the cadmium concentrations (i.e., only those samples with elevated cadmium concentrations had elevated silver concentrations as shown in the figure below). As a result, it is likely that the elevated metals concentrations in the groundwater samples interfered with the ICP/MS silver analyses resulting in elevated concentrations. As such, the September 2010 silver data will not be discussed in the evaluation below."



*b) A possible explanation for the elevated silver results is provided; however, there is no possible explanation offered for the order of magnitude lower concentrations detected for zinc in the September 2010 sampling event. As above, it is unclear why all of the September 2010 zinc detections would not be an order of magnitude lower as well.*

**Response:** Based on review of the laboratory report for the September and October 2010 and historical laboratory reports, it is likely that the order of magnitude lower zinc detections are due to the concentrations being calculated using the results from the 213.8 nm wavelength as compared to the 206.2 nm wavelength during the ICP-AES analyses. When the 206.2 nm wavelength data were used to calculate the zinc concentrations for the October 2010 analyses, the zinc concentrations are consistent with historical trends.

**Illinois EPA Review:** *This should be included in the revised report text.*

**Review Response:** The report text will be revised as follows:

**"Zinc:** Zinc data collected in September 2010 do not agree with data collected during past sampling events and do not appear to be representative of site conditions. The zinc concentrations measured in September 2010 in the permanent monitoring wells (HS-03(S), HS-05(S), HS-06(S), PS-17, HS-08(S), and MW-35U) are approximately one order of magnitude lower than the concentrations

measured in previous sampling events. The zinc concentrations measured in October 2010 in these wells are in agreement with previous sampling events. The zinc concentrations measured in monitoring well HS-09(S) and MW-39U in September and October 2010 are similar to the concentrations measured in previous sampling events. Based on review of the laboratory report for the September and October 2010 and historical laboratory reports, it is likely that the order of magnitude lower zinc detections are due to the concentrations being calculated using the results from the 213.8 nm wavelength as compared to the 206.2 nm wavelength during the ICP-AES analyses. When the 206.2 nm wavelength data were used to calculate the zinc concentrations for the October 2010 analyses, the zinc concentrations are consistent with historical trends. Historical concentration data are not available for the temporary monitoring wells in the transects. Based on the lack of consistency with previous sampling events, the September 2010 Zinc data will not be discussed in the evaluation below."

*c) The text states that silver and zinc will not be discussed in the evaluation, yet both are still included in the discussions. Sulfate concentrations are shown in Appendix L, but there is no discussion of them in the text.*

**Response:** References to silver and zinc have been removed from the discussion and from Appendix L. The following discussion of the sulfate results will be added to the second paragraph under **Transect 1**: "As shown on the figures and in Table 4-17, the effects of the North IRM Wall are variable depending upon the constituent. Concentrations of arsenic, cadmium, cobalt, nickel, and sulfate in the monitoring wells immediately upgradient and downgradient of the North IRM Wall (TW-01U [upgradient] and HS-03(S) [downgradient]) were relatively the same."

**Illinois EPA Review:** *As this response only references a revision to the Transect 1 discussion, it is unclear whether the discussions for the other transects will be revised accordingly (e.g., arsenic and copper in Transect 2 and arsenic, cadmium and lead in Transect 3). Please clarify.*

**Review Response:** To evaluate sulfate for Transects 2 and 3, the following discussions of sulfate will be added to the applicable sections of the text. The discussion in the third paragraph under Transect 2 will be revised as follows: "The North IRM Wall appears to be reducing the concentrations for cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc, and sulfate across the North IRM Wall as observed for monitoring wells HS-05(S) as compared to HS-06(S) and PS-17. The arsenic concentrations remained relatively the same in these three wells." The discussion in the fourth paragraph under Transect 2 will be revised as follows: "Concentrations of arsenic, cadmium, cobalt, iron, manganese, nickel, zinc, and sulfate were similar in the groundwater upgradient of the Central IRM Wall (monitoring well PS-17) as compared the HS-08 located downgradient of the Central IRM Wall and North Interceptor System. The concentrations of copper and lead decreased as groundwater flowed across the Central IRM Wall." The fifth paragraph under Transect 2 will be revised as follows: "Concentrations of cadmium, cobalt, copper, lead, manganese, nickel, zinc, and sulfate decreased downgradient of the South IRM Wall/South Interceptor Trench (monitoring wells HS-08(S) to HS-09(S) and MW-39U). Concentrations of arsenic and iron increased from HS-08(S) to HS-09(S) and then concentrations decreased in monitoring well MW-39U." The discussion in the third paragraph under Transect 3 will be revised as follows: "The North IRM Wall appears to be decreasing concentrations for cobalt, copper, iron, manganese, nickel, zinc, and sulfate across the North IRM Wall as seen for wells MW-35U as compared to TW-05U (see Table 4-17). The cadmium concentrations remained relatively the same in these two wells and the lead concentration increased slightly in well TW-05U as compared to the concentrations in MW-35U." The discussion in the fourth paragraph under Transect 2 will be revised as follows: "Decreasing concentrations trends for cadmium, cobalt, copper, lead, manganese, nickel, zinc, and sulfate were observed in the groundwater from upgradient of the North Interceptor Trench Extension (monitoring well TW-05U) to downgradient (monitoring well TW-06U). The iron concentration increased between TW-5U and TW-

6U.” The fifth paragraph under Transect 2 will be revised as follows: “Concentrations of cadmium, cobalt, copper, lead, manganese, nickel, zinc, and sulfate remained essentially the same between TW-6U located north of the presumed location of the south IRM Wall/South Interceptor System and TW-7U and TW-8U to the south. The concentrations of iron decreased between TW-06U to TW-07U and then increased in monitoring well TW-08U. The increase in iron content at TW-8U may be from the railroad ballast in the railroad corridor.”

**Comment 42d) Transect 1:**

3. *A review of the boring logs for Transect 1 wells suggests that the decrease in metals to the south along the transect could have another explanation besides interaction with the IRM System. Wells TW-02U and TW-03U are screened in peat. Metals concentrations in these groundwater samples may be decreased by geochemical or other sequestration capacities associated with the peat. Well TW-04U is screened in silt and is likely not hydraulically connected with the UWBZ (hence the persistent, unusually high water level observed at this location). It is likely screened in fill material placed to allow the rail road to cross the historic South Ditch.*

**Response:** The screen intervals for TW-02U and TW-03U straddle the interface between the fill and the peat and the well screens are exposed to both units and provide adequate data regarding the metals concentrations in the UWBZ at these locations. ENVIRON acknowledges that the well screen for TW-04U is placed within a silt material. However, this silt material is located above the peat layer and meets the definition of the UWBZ outlined in the Phase II RI Work Plan and is at approximately the same elevation as the UWBZ at the FPSA.

**Illinois EPA Review:** *The original comment was not meant to question the adequacy of the data to represent metals concentrations in the UWBZ. It was seeking an interpretation of the data. If ENVIRON believes “the IRM Wall does not appear to be effective at treating groundwater”, and the South Interceptor Trench Extension provides no treatment capability (only groundwater collection during high water level periods) what explanation can be provided for the decrease in metals concentrations along Transect 1? Identification of and understanding the site-specific mechanisms that appear to inhibit metals mobility may be important for future remedial decisions. What explanation can be provided for the persistent high water level in TW-04U?*

**Review Response:** The ENVIRON quotation above (i.e., if ENVIRON believes “the IRM Wall does not appear to be effective at treating groundwater”) is taken out of context. The full quotation from response to comment 42d(2) is as follows: “Based on this data, the North IRM Wall does not appear to be effective at treating groundwater; however, the evaluation of effectiveness of the North IRM wall is difficult because the upgradient (TW-01U) and downgradient [HS-03(S)] monitoring wells are both screened within slag source material.”

The second to the last paragraph under “Transect 1” will be revised as follows: “Decreasing concentration trends for the metals (arsenic, cadmium, cobalt, copper, iron, lead, and manganese) and sulfate [see Figures L-1 through L-11 in Appendix L] are observed in the groundwater as it flows past the South Interceptor Trench Extension and downgradient of the slag pile (monitoring wells TW-02U, TW-03U, and TW-04U). These trends are seen both prior to and after the Trench Shutdown and may be due to a combination of features including the effects of the south interceptor trench collection, the thinning of the UWBZ observed at TW-03U, potentially the sequestration capacity of the underlying peat, precipitation of metal oxyhydroxides/sulfides, metals sorption processes, and the change in composition of UWBZ material from slag material to sandy and gravelly silty clay.”

The persistent high water level in TW-04U is likely due to the well screen placed in lower conductivity silt.

**Comment 42e) Transect 2:**

3. *Iron should not be included in the group of metals that decreased downgradient of the south IRM wall/south interceptor trench. Similar to arsenic, its concentration significantly increased from HS-08(S) to HS-09(S) and then decreased at MW-39U.*

Response: Acknowledged.

**Illinois EPA Review:** Not sure what "Acknowledged" means. Will the text be revised?

Review Response: Acknowledged means that the comments is accepted. The text will be revised to read "Concentrations of cadmium, cobalt, copper, lead, manganese, nickel, and sulfate decreased downgradient of the South IRM Wall/South Interceptor Trench (monitoring wells HS-08(S) to HS-09(S) and MW-39U)."

**Comment 42e) Transect 2 (continued):**

- 4 *As suggested in the text, the North IRM Wall appears to be reducing metals concentrations for cadmium, cobalt, copper, iron, lead, manganese, nickel, zinc, ammonia, and sulfate. However, the zone between HS-06(S) and PS-17, where no IRM Wall components are located, also appears to be reducing metals concentrations, making it unclear whether the reduction observed in flow across the North IRM is related to IRM treatment, or some other combination of factors. With the exception of copper and lead, concentrations appear to generally increase across the Center IRM Wall.*

Response: The text will be revised as follows: "The North IRM Wall appears to be reducing the metals concentrations for cadmium, cobalt, copper, iron, lead, manganese, and nickel and sulfate across the North IRM Wall as observed for monitoring wells HS-05(S) as compared to HS-06(S). The arsenic concentrations remained relatively the same in these wells. As mentioned above, the evaluation of effectiveness of the North IRM wall is difficult because the upgradient [HS-05(S)] and downgradient [HS-06(S)] monitoring wells are both screened within slag source material. The concentration of metals between HS-06(S) and PS-17 also show a general decrease, which is may be a result of the presence of less slag material in the UWBZ at PS-17 and the presence of 3.5 feet of sand between the slag and underlying peat.

Upgradient and downgradient of the Central IRM Wall [PS-17 to HS-08(S)], the concentrations of arsenic, cobalt, and nickel are similar; the concentrations of cadmium, and manganese slightly increase; and the concentrations of copper and lead decreased. The concentration of sulfate between PS-17 and HS-08(S) is approximately the same."

**Illinois EPA Review:** The proposed text revision is not completely accurate. Per the boring log, PS-17 does not have sand present between the slag and the peat. The interval from 5 to 8.5 feet bgs is "SAA (same as above – residue [slag]) with gravel. This should be clarified in the text above. Overall it appears that the ability of the North IRM Wall to reduce metals is uncertain, at best. Given the short distance between HS-05(S) and other downgradient wells along the transect, it seems unlikely that small variations in the quality or quantity of slag material would have a significant effect on concentrations; metals within groundwater at HS-05(S) would be expected to migrate the 80 feet to PS-17 without a significant decrease in concentration regardless of the amount of slag material at PS-17.

Identification of some of the metals' trends can be different than that presented in the response. A slight increase (or decrease) may be interpreted as "similar". In actuality the effect of the IRM Walls appears to be slight (see graphs below). The significant feature to be evaluated and discussed is the

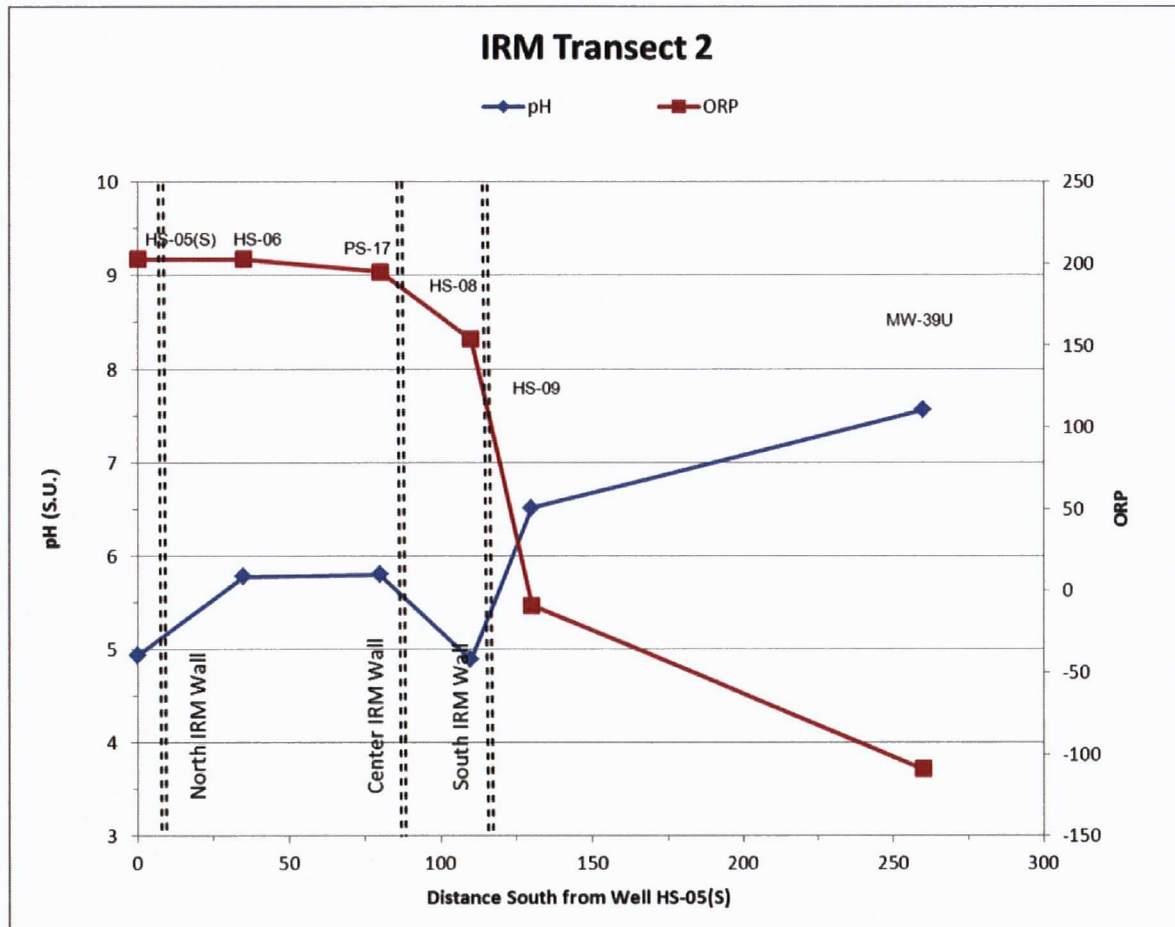
geochemistry south of the IRM System, i.e., at HS-09 and beyond. South of the system the pH increases > 6, the ORP of the groundwater indicates stronger reducing conditions, alkalinity increases dramatically (seen from Phase I data), ferrous iron ( $\text{Fe}^{2+}$ ) concentrations increase, cationic metals (Cd, Cu, Pb) decrease significantly, and sulfate and zinc concentrations begin to drop off, and fall precipitously at greater distance (at MW-39U) from the system. The same general pattern is observed in Transect 1 and Transect 3. These conditions should be evaluated in terms of pH-driven precipitation or adsorption reactions, iron- and sulfate-reduction, and potential metal-sulfide or metal-iron-sulfur mineral precipitation.

IRM Transect 2	Distance	Zinc	Cadmium	Lead	Copper	Sulfate	Iron
HS05	0	238,000	5,290	720	83,600	11,000	12,800
HS06	35	210,000	3,790	623	88,500	7,000	100
PS-17	80	189,000	2,080	421	66,300	6,100	1,310
HS08	110	212,000	2,430	244	17,700	5,600	3,450
HS09	130	105,000	9.5	1	25	2,200	107,000
MW-39U	260	22.3	5	1	25	100	3,670





IRM Transect 2	Distance	pH	ORP
HS05	0	4.93	203
HS06	35	5.78	203
PS-17	80	5.8	195
HS08	110	4.89	154
HS09	130	6.51	-9
MW-39U	260	7.56	-109



**Review Response:** ENVIRON was not able to locate the ferrous iron ( $\text{Fe}^{2+}$ ) data referenced in the Illinois EPA comment above in the project database, the Data Report, or the Phase I RI. The text will be revised to read: "Based on the groundwater data obtained prior to and after trench shutdown, the North IRM Wall appears to be reducing the metals concentrations for cadmium, cobalt, iron, lead, manganese, and nickel and sulfate across the North IRM Wall as observed for monitoring well HS-05(S) as compared to HS-06(S). The sample obtained after trench shutdown indicates that copper may also be reduced. The arsenic concentrations remained relatively the same in these wells. As mentioned above, the evaluation of effectiveness of the North IRM wall is difficult because the upgradient [HS-05(S)] and downgradient [HS-06(S)] monitoring wells are both screened within slag source material. The concentration of metals between HS-06(S) and PS-17 also show a general decrease."

As discussed in the IEPA review, pH-driven precipitation or adsorption reactions, iron- and sulfate-reduction, and potential metal-sulfide or metal-iron-sulfur mineral precipitation may all play a role in

the observed changes in groundwater chemistry across the IRM Wall/shallow Interceptor system and from HS-09 to MW-35U. Identification of the exact mechanisms and the percent contribution of each mechanism to the observed changes would only be possible with detailed geochemical/mineralogical studies and still may not yield a definitive answer.

**Comment 42f) Transect 3:**

1. *It's our understanding that the north interceptor trench extension is essentially a near-surface feature that was placed to prevent groundwater from breaching the ground surface, and as such would have no effect on the concentrations of metals in groundwater. This should be clarified in the text.*

**Response:** The text will be revised as follows: "The north interceptor trench system was installed to approximately 3 to 4 feet bgs and tied into the existing interceptor trench system. The north interceptor trench extension was placed to maintain the UWBZ water table at an elevation below land surface. The north interceptor trench system would not have an effect on groundwater treatment unless the water table rises to the elevation of the north interceptor trench extension."

**Illinois EPA Review:** *The text should reflect the fact that groundwater treatment, in the sense that IRM is supposed to provide some metals removal as an in-situ treatment, is different than the groundwater collection aspect provided by the North Interceptor Trench. The Interceptor provides no treatment. As the water table rises it collects groundwater, which is then piped to the IWTP for treatment.*

**Review Response:** The term "treatment" in the response implied capture and treatment by the IWTP. The text will be revised to read: "The north interceptor trench system was installed to approximately 3 to 4 feet bgs and tied into the existing interceptor trench system. The north interceptor trench extension was placed to maintain the UWBZ water table at an elevation below land surface. The north interceptor trench system would not have an effect on groundwater treatment unless the water table rises to the elevation of the north interceptor trench extension where the water is then piped to the IWTP for treatment."

**Comment 42f) Transect 3 (continued):**

- 2 *As was observed in Transect 2, the zone between TW-5U and TW-6U contains no IRM wall material or other treatment system components, yet large concentration reductions are observed for cadmium, cobalt, copper, lead, manganese, nickel, zinc, and sulfate. An increase in iron and ammonia also occurs in this zone. What are the mechanisms for these concentration decreases (and increases) and how should they be interpreted in terms of evaluating the effectiveness of the IRM material?*

**Response:** Groundwater advection and dispersion and metals retardation by the soil media play a role in the observed decreases in concentrations. Increases in iron and ammonia concentrations may be due changes in the redox state of the subsurface materials. It is not possible to definitively identify the mechanisms responsible for the observed changes in analyte concentrations.

**Illinois EPA Review:** *A definitive identification of the mechanisms is not required, but some further evaluation of the available data should be made by the DePue Group to identify the effects on groundwater geochemistry, from the IRM System and from the railroad. This was one of the objectives for the Phase II investigation. As it stands now, it appears that the IRM material is not the cause of major reductions in metals concentrations, groundwater collection is the primary asset afforded by the system, and the major metals reduction process (undefined by the DePue Group) is occurring via mechanisms possibly unrelated to the system.*

**Review Response:** Based on the data collected during the IRM Wall investigation, similar concentrations of COPCs prior to and after trench shutdown were observed. This would not be expected if the IRM material did not contribute to the reductions in metals concentrations along the IRM transects. The change in COPC concentrations across the IRM transects is likely due to a combination of features including the interceptor trench collection, effects of the IRM material, thinning of the UWBZ, the sequestration capacity of the underlying peat, and the change in the composition of the UWBZ from slag fill material upgradient to native sands, silts, and clays at the downgradient-most monitoring wells in the transect. The geochemical and physical mechanisms responsible for the overall decreases likely include adsorption, precipitation, advection, dispersion, reduction, and cation exchange.

**Comment 42f) Transect 3 (continued):**

3 As with wells TW-4AU [sic] (Transect 1) and MW-39U (Transect 2), well TW-8U appears to be installed within the general fill material placed for railroad construction and is unlikely to be representative of the UWBZ below the Slag Pile.

**Response:** Well TW-8U is not located below the Slag Pile, therefore, the material encountered at TW-8U is not expected to be representative of the UWBZ below the Slag Pile.

**Illinois EPA Review:** The point of the comment was that the boring log for TW-08 suggests that the screened interval within the native (?) sandy silt is unlike the water bearing fill material associated with the UWBZ. The text should discuss the potential effect the different soil material screened in TW-8U has on the groundwater geochemistry when compared to wells upgradient on Transect 3? The text mentions increased iron is due to "railroad ballast in the railroad corridor". The log mentions no railroad ballast, only slag and retort. How does railroad ballast, typically comprised of quartzite, cause increased dissolved iron?

**Review Response:** The text will be revised to indicate that the screen placement for TW-08 placed in the sandy silt may result in the observed changes in groundwater chemistry from TW-07U to TW-08U. The text indicates that the increase in iron may be from the railroad ballast in the railroad corridor. Railroad ballast can be comprised of many types of materials including granite, quartzite, dolomite, or limestone, and slag (according to the National Slag Association, before the 20th century, slag's principle use in this country was as track ballast for the nation's railroads (<http://www.nationalslag.org/slaghistory.htm>)). If slag was used as railroad ballast in the past, it could cause an increase in dissolved iron.

**Comment 47. Section 5.1.1, Lithopone Ridges Area, page 60:**

c) As shown in Table 4-3, the concentrations of total metals by aqua regia in the native material are less than those of the non-native material; however, arsenic, iron, and manganese still exceed HCOPC screening levels and should be called out in the text and highlighted on Table 4-3.

**Response:** See response for Comment 47a.

**Illinois EPA Review:** Response is acceptable in regards to highlighting Table 4-3. The fact that arsenic, iron and manganese still exceed HCOPC screening levels in the peat should be called out in the text.

**Review Response:** Iron (33,200 mg/kg) was not detected greater than the HCOPC screening level of 55,000 mg/kg in the peat sample obtained from SB-31. The following sentence will be added to the end of the Total Metals by Aqua Regia Results portion of Section 5.1.1.2: "In the peat sample at SB-31, arsenic and manganese were detected greater than direct contact HCOPC screening levels. Arsenic was also detected greater than the direct contact HCOPC screening levels in the aquitard

and aquifer samples collected at SB-31. However, arsenic by aqua regia was not detected in the native soil samples greater than the Illinois background of 11.3 mg/kg or the site specific background of 11.6 mg/kg."

**Comment 51.** *Section 5.1.4, Upland Portion of the Southeast Area, page 62: As shown in Table 4-3, the concentrations of total metals by aqua regia in the UPSEA native material are less than those of the non-native material; however, arsenic still exceeds HCOPC screening levels and should be called out in the text.*

**Response:** The text will be revised to include "with elevated concentrations of arsenic present" at the end of the paragraph in Section 5.1.4.2.

**Illinois EPA Review:** *The text should be revised to say "However it should be noted that arsenic still exceeds HCOPC screening levels in the native materials" at the end of the first paragraph in Section 5.1.4.2.*

**Review Response:** The following sentences will be added to the end of the Total Metals by Aqua Regia Results under Section 5.1.4.2: "However arsenic is present greater than the HCOPC screening level. It should be noted that arsenic was not detected in the native material samples greater than the Illinois EPA background concentration of 11.3 mg/kg or the site specific background of 11.6 mg/kg."

**Comment 56.** *Section 5.2.2, Former Settling Ponds, pages 67-68:*

*a) The surface water and sediment concentrations of the Settling Ponds samples should be compared to ECOPC screening levels.*

**Response:** Tables 5-5 and 5-6 will be revised with the ECOPC screening levels and the surface water data presented in Table 5-5 has also been revised to compare the results to the Illinois EPA general use water quality standards presented in 35IAC.302.208, where available. Total barium, copper, iron, and manganese were detected at concentrations greater than the ECOPC screening level in both settling ponds and cobalt was detected greater than the ECOPC screening level at SP-2. Total iron and manganese were detected greater than the general use water quality criteria at SP-1. Dissolved barium, copper, iron, and manganese were detected greater than the ECOPC screening level in both settling ponds. Dissolved aluminum, cadmium, lead, and zinc were detected greater than the ECOPC screening level at SP-2 only. The concentration of dissolved manganese at SP-1 is greater than the general use water quality criteria. Ammonia was also detected greater than the ECOPC screening level of 4.6 mg/L in both settling ponds.

The surface water sample from seep N004 obtained in July 2009 contained aluminum, barium, cadmium, copper, iron, lead, manganese, zinc, ammonia, and sulfate at concentrations greater than their respective ECOPC screening levels. The concentration of iron is also greater than the general use water quality standard.

For sediment, the concentrations of arsenic, cadmium, copper, lead, manganese, and zinc were detected at concentrations greater than the ECOPC screening level in both settling ponds. Chromium, iron, mercury, nickel, and silver were detected in sediment samples from SP-2 at concentrations greater than their respective ECOPC screening levels.

**Illinois EPA Review:** *Response is acceptable. Please include this discussion in the text.*

**Review Response:** The text above regarding the surface water results will be incorporated into the Preliminary Phase II RI Report at the end of Section 5.2.2.1. The last paragraph above will be incorporated at the end of Section 5.2.2.2.

**Comment 57.** *Section 5.2.4, Shoreline Seeps, pages 69-70:*

*b) The text should provide an interpretation for the source of seeps N003, N004, N005, and N006. The occurrence of several metals in the seeps suggests a UWBZ source.*

**Response:** The following paragraph will be added under 5.2.4: "A comparison of the N-series seep data to the Lower Aquifer and UWBZ groundwater data summarized in Table 5-10 indicates that the COPC concentrations in N-series seeps are similar to the groundwater concentrations measured in the Lower Aquifer."

**Illinois EPA Review:** *Please provide a separate comparison table for each of the seeps that documents the statement made in the response. Please use all available metals and other water quality data, however, the comparisons should be based on data collected during the same sampling dates. For example, Table 5-10 has seep data for N005 only for August 2007 and July 2008. These should be the dates used to compare against nearby monitoring well results. There is not a lot of data to use for the comparisons, and for some constituents the seep results appear to be similar to the Lower Aquifer while other results appear to be similar in concentration to the UWBZ, making the conclusion difficult to discern.*

*An additional issue is that, if seeps N003, N004, and N005 are Lower Aquifer discharge points, then where are the discharge points for the UWBZ water in wells W-18(S), HS-12(S) and other UPSEA shallow wells? Could seeps N003, N004, and N005 be a combination of discharge from the Lower Aquifer and the UWBZ?*

**Review Response:** The following paragraph will be added to the end of the second paragraph under Section 5.2.4: "Tables 5-9A, 5-9B, and 5-9C provide a comparison of springs N003, N004, and N005, respectively to groundwater data from obtained from nearby UWBZ and Lower Aquifer monitoring wells during the same sampling event. The results of the comparisons are as follows:

- **N003:** Table 5-9A provides a comparison of the data obtained from spring N003 in August 2007 and July 2008 to the nearest UWBZ and Lower Aquifer monitoring wells west of the South Ditch, W-18(S), MW-27T, and W-18(D) and upgradient UWBZ monitoring well MW-39U from the same quarterly monitoring events. As shown in the table, the concentrations of barium measured at N003 are more similar in concentration to UWBZ wells W-18(S) and MW-39U than to the Lower Aquifer monitoring wells, whereas the concentrations of zinc, ammonia, phosphorus, and sulfate measured at N003 are similar to concentrations of these analytes measured in Lower Aquifer monitoring wells MW-27T and W-18(D). The manganese results from N003 were similar to data obtained from both the UWBZ and Lower Aquifer, but the concentrations of iron measured at N003 are not similar to the groundwater data obtained from either aquifer.
- **N004:** Table 5-9B provides a comparison of the data obtained from spring N004 in August 2007 and July 2008 to nearby UWBZ monitoring well HS-12(S) and nearby TOLA monitoring well MW-13(I) during the same quarterly monitoring events. As shown in the table, the concentrations of arsenic, manganese, ammonia, and phosphorus measured at N004 are more similar to the concentrations of these analytes detected in the Lower Aquifer than the UWBZ, and the concentrations of aluminum, copper, iron, lead, and zinc measured at N004 are not similar to the groundwater data obtained from either aquifer. The barium results from N004 were similar to

data obtained from both the UWBZ and Lower Aquifer. The concentration of sulfate measured at N004 is more similar to, but greater than, the data obtained from UWBZ monitoring well HS-12(S). In addition, the presence of reddish discoloration in spring N004 in November 2012 similar to the reddish discoloration in the eastern settling pond, SP-2, suggests that there is a potential contribution from the eastern settling pond to spring N004.

- **N005:** Table 5-9C provides a comparison of the data obtained from spring N005 in August 2007 and July 2008 to nearby upgradient UWBZ monitoring well W-18(S) and Lower Aquifer monitoring wells MW-27T and W-18(D) during the same quarterly monitoring events. As shown in the table, the concentrations of barium, cobalt, manganese, nickel, zinc, fluoride, phosphorus, and sulfate are more similar to the concentrations measured in the Lower Aquifer monitoring wells than the UWBZ monitoring wells, and the concentrations of ammonia measured at N005 are not similar to the groundwater data obtained from either aquifer. With the exception of the iron concentration measured at W-18(S) in August 2007, the concentrations of iron measured at N005 are generally similar to the concentrations measured in both the UWBZ and the Lower Aquifer.

The results of the comparison of the data obtained at springs N003, N004, and N005 suggest that these springs most likely receive contributions from both the UWBZ and Lower Aquifer.'

Tables 5-9A, 5-9B, and 5-9C are included in Attachment 6.

*d) A review of the data for UWBZ wells upgradient of the shoreline seeps (i.e., MW-23U, MW-24U, W-17S in the Eastern Area) shows cadmium, lead, manganese, and zinc exceedances of the HCOPC screening levels. These same metals exceed HCOPC screening levels in the shoreline seeps. A review of the data for the TOLA/BOLA wells upgradient of the shoreline seeps (i.e., MW-45B, MW-46T/B, MW-48T/B, MW-47T/B, MW-20B, PS-11, W-22T/B, W-17D, MW-23T) show only manganese, and occasional iron and sulfate exceedances. Cadmium, lead, and zinc concentrations are consistently near or below the detection limit in all of these upgradient Lower Aquifer wells. Consequently, the conclusion would be that the COPC constituents in the shoreline seeps are more similar to the groundwater constituents detected in the UWBZ, not the Lower Aquifer. What is the basis for stating that the COPC concentrations in shoreline seeps SP01 through SP-10 are similar to the groundwater concentrations measured in the Lower Aquifer?*

**Response:** The UWBZ is not present in the area immediately upgradient of the shoreline seeps or within the residential portion of the Village of DePue upgradient of shoreline seeps SP-1 through SP-10; therefore, the UWBZ cannot be the source of the shoreline seeps SP-1 through SP-10. A comparison of data from Seep SP-1 to upgradient BOLA well MW-45B indicates similar concentration values for iron, manganese, and sulfate. A comparison of data from seep SP-10 to upgradient Lower Aquifer wells MW-48T and MW-48B indicate similar concentrations of iron and sulfate. Comparison of the shoreline seep data to some wells listed above such MW-20B, PS-11, W-22T/B, W-17D, and MW-23T that are located over 1,000 feet upgradient of the shoreline seep is not appropriate. Seep concentrations measured at SP-04 through SP-08 may also be influenced by the proximity to the Division Street Drain area or from material placed on the lake shore.

### **Illinois EPA Review:**

- *It's not clear why seep SP-01 was compared to MW-45B. Seep SP-02 is actually closer and more directly downgradient of MW-45B than SP-01, and provides a better point of comparison. Concentrations of iron and manganese are over 1000% greater in the Lower Aquifer than in the seep at this location. The seep SP-02 contains concentrations of cadmium, copper, lead and zinc that are not detected in the Lower Aquifer sample.*

		Al	As	Ba	Cd	Ca	Cu	Fe	Pb	Mn	Ni	Zn	Ammonia	Nitrate	Phosphorus	Sulfate
SP-02	7/23/2010	ND	ND	85.4	0.56 J	124,000	3.1 J	205	0.98 J	26.1	2.6 J	31.7	ND	ND	ND	92
MW-45B	7/21/2010	76.1 J	1.8	140	ND	118,000	ND	3,310	ND	293	0.64 J	3.2	ND	0.032	0.11	110

- *The comparison of SP-10 to upgradient Lower Aquifer well MW-48T shows that only sulfate, phosphorus, and calcium concentrations are similar. When concentrations in samples collected during the same sampling event are compared, levels of aluminum, barium, cadmium, copper, iron, lead, nickel, and zinc are greater in SP-10. It is not clear how this provides evidence that the seep water and Lower Aquifer water are similar.*

Average concentration: May 22 & Nov 18, 2010		Al	As	Ba	Cd	Ca	Cu	Fe	Pb	Mn	Ni	Zn	Ammonia	Nitrate	Phosphorus	Sulfate
SP-10		2124.1	ND	200	ND - 17.8	154,500	47.55	6576.5	42.875	84.9	11.2	1149.4	ND - 0.64	ND - 0.48	0.225	195
MW-48T		ND	ND - 1.2	51.3	ND	125,000	ND	3175	ND	191.5	ND - 1	ND	1.25	ND	ND - 0.1	145

- *Cadmium concentrations above the screening level were also found in seep samples SP-03, SP-04, SP-06, SP-07, SP-08, and SP-10, when cadmium was always nondetect in the Off-site TOLA/BOLA wells. Comparisons were made to wells MW-20B, PS-11, W-22T/B, W-17D and MW-23T because these upgradient wells also show limited or periodic metals contamination in the Lower Aquifer.*

**Review Response:** The reference to the seep data being more similar to the Lower Aquifer groundwater analytical results will be removed from the text and replaced with the following:

“The UWBZ has not been encountered in the area immediately upgradient of the shoreline seeps or within the residential portion of the Village of DePue upgradient of the shoreline seeps SP-1 through SP-10; therefore, the Lower Aquifer is the source of the shoreline seeps.”

**Illinois EPA Review (continued):**

*The response suggests that seep concentrations measured at SP-04 through SP-08 may be attributable to off-site source areas (i.e., Division Street Drain or site-related material placed on the lakeshore). In fact seeps SP-02, SP-03, SP-09 and SP-10 also have concentrations of cadmium, lead, and zinc that typically exceed HCOPC or ECOPC screening levels that may be impacted by off-site sources. The Supplemental Soil Investigation conducted for OU5 identified soil source areas below elevation 450 ft amsl that could impact water discharging from the Lower Aquifer, but definition of the nature and extent of off-site lake-shore source areas, particularly for seeps SP-02 through SP-06, has not been completed and there currently appear to be no plans in place under OU3, OU4, or OU5 to address this data gap.*

**Review Response:** See response to General Comment 2.

**Illinois EPA Review (continued):**

*The ground surface elevations used for the seeps/springs were measured by Arcadis for Operable Unit 5, but it is not clear whether the stated elevations provided by Arcadis represent the head of the seep/spring or the elevation of the sampling location by ENVIRON. At some locations the head of the seep may be different than the sampling location, e.g., SP-04, SP-05, SP-06. Illinois EPA requests the DePue Group to check and verify what the elevations measurement actually represent.*

**Review Response:** The elevations of the shoreline seeps were measured by Chamlin and Associates in July 2010 and have been incorporated in Table 4-12. The elevation measurements were taken at the approximate head of the seep determined at the time of the survey. The photographic log included in Appendix H of the Preliminary Phase II RI shows the relationship of some of the survey points to the seep location. Table 4-12 is included in Attachment 6.

**Comment 61.** *The following comments include locations where Phase II exceedances were identified on Table 5-10, but omitted from the text discussion.*



**Arsenic:**

- Also detected at PZ-01(S)R in the Slag Pile Area.
- The highest concentration during Phase II was 96.4 ug/L at HS-05(S), located in the Slag Pile Area.
- The extent of arsenic in groundwater greater than the HCOPC screening level also includes the north and central portion of the Lithopone Ridges Area and the western portion of the Slag Pile Area.

**Response:** Arsenic was detected at a concentration greater than the HCOPC screening level at MW-41U in June 2008 and was not detected during the remaining three sampling events.

**Illinois EPA Review:** *The response is not appropriate to the comment; the bullet items for arsenic (above) need to be included in the text or the text revised to incorporate the corrections highlighted above.*

**Review Response:** The text for arsenic in the UWBZ will be revised as outlined below. The results of the Mann-Kendall evaluation are included in Attachment 7.

**Arsenic**

As shown on Figure W-1 and in Table 5-10, arsenic was detected greater than the HCOPC screening level of 10 µg/L during the Phase I and Phase II RIs at the following locations:

- Bluff Area: Arsenic was detected in groundwater greater than the HCOPC screening level at Bluff Undifferentiated monitoring wells W-02(S), W-03(S), and W-04(S). Based on the Mann-Kendall trend test results presented in Appendix U, a decreasing concentration trend is present at W-02(S) and W-04(S) and a concentration trend was not observed at W-03(S).
- Eastern Area: Arsenic was detected in groundwater greater than the HCOPC screening level during the Phase I and Phase II RIs at UWBZ monitoring well PS-03 and during three of eight monitoring events at aquitard well PS-04. PS-03 and PS-04 are located in the north-central portion of the Eastern Area. Arsenic was also detected at UWBZ monitoring well W-06(S) during the first Phase I RI monitoring event in December 1999 but was not detected greater than the HCOPC screening level during the three subsequent monitoring events conducted during the Phase I RI or the first monitoring event conducted during the Phase II RI. Based on the Mann-Kendall trend test results presented in Appendix U, a concentration trend was not observed at PS-03 and PS-04.
- Lithopone Ridges Area: Arsenic was detected in groundwater greater than the HCOPC screening level at PS-13 during the four Phase I RI monitoring events and the first of the four Phase II RI monitoring events in August 2007 but was not detected greater than the HCOPC screening level in the subsequent three monitoring events. Arsenic was also detected greater than the HCOPC screening level at MW-41U during the second (6/26/2008) of four monitoring events but was not detected in November 2007 and January and April 2009. Based on the Mann-Kendall trend test presented in Appendix U, a decreasing concentration trend was observed for arsenic at PS-13.
- Slag Pile Area: Arsenic was detected in groundwater greater than the HCOPC screening level at HS-01(S), HS-05(S), HS-06(S), PS-17, PZ-01(S)R, PZ-02(S), PZ-04(S)R, W-08(S), W-09(S), MW-35U, and W-11(S). Arsenic at HS-01(S) was detected greater than the HCOPC screening level during two sampling events in 2000 as part of the Phase I RI, but was not detected greater than the screening level in five subsequent sampling events ending in April 2009. Arsenic was detected marginally greater than the HCOPC screening level at HS-06(S) and PS-17 in August 2000, which was one of five sampling events, so these wells were not sampled after August



2007. Monitoring wells PZ-04(S)R, MW-35U, W-08(S), and W-09(S) each had a detection of arsenic greater than the HCOPC screening level during one monitoring event. Mann-Kendall trend tests performed on HS-01(S), HS-05(S), and W-11(S) included in Appendix U indicate that concentration trends were not observed.

- UPSEA: Arsenic was detected greater than the HCOPC screening level at HS-08(S), HS-09(S), HS-11(S), HS-12(S), MW-29U, and W-19(S). Mann-Kendall trend tests were performed on the above locations, with the exception of MW-29U, which only had four quarters of data. Based on the Mann-Kendall analysis outlined in Appendix U, no trends in the arsenic concentrations were observed in the UWBZ at these locations.

As shown on Figure W-1, the highest concentration of arsenic detected in the UWBZ during the Phase II RI was 96.4 µg/L at HS-05(S) located in the Slag Pile Area. The extent of arsenic in groundwater greater than the HCOPC screening level in the UWBZ is generally confined to the north-central portion of the Eastern Area, the western portion of the Slag Pile Area, at the southern extent of the UPSEA east of the settling ponds. In addition, arsenic above the HCOPC screening level was observed at PS-13 prior to August 2007 and at MW-41U in June 2008. Monitoring wells PS-13 and MW-41U are located in the north and central portions of the Lithopone Ridges Area. The concentrations of arsenic measured in the UWBZ during the Phase II RI are generally less than or similar to the concentrations measured during the Phase I RI.

***Comment 61 (continued):***

***Cobalt:***

- *Also detected at MW-41U in the Lithopone Ridges Area.*

***Response:*** Cobalt was detected at a concentration greater than the HCOPC screening level at MW-41U during one out of four monitoring events (i.e., June 2008). Cobalt was not detected at concentrations greater than the HCOPC screening level in two subsequent events.

***Illinois EPA Review:*** *If the discussion of results is to be qualified as such (i.e., one HCOPC exceedance and then not sampled again since 2009), the revised text should include such a statement.*

***Review Response:*** The text for the cobalt discussion under Section 5.3.3.1 will be edited as follows:

Cobalt was detected greater than the HCOPC screening level of 1,000 µg/L at HS-03(S), HS-04(S), HS-05(S), HS-06(S), PS-17, MW-35U, W-08(S), W-09(S), and W-11(S) in the southern portion of the Slag Pile Area, MW-41U in the Lithopone Ridges Area, and HS-08(S) and HS-09(S) in the northern portion of the UPSEA. The detection of cobalt greater than the HCOPC screening level at MW-41U occurred in one of four sampling events (June 2008) and was not detected greater than the HCOPC screening level in the subsequent two sampling events in January and April 2009.

***Comment 61 (continued):***

***Iron:***

- *For the Slag Pile Area, the concentration at PZ-03(S) is not considered one of the highest concentrations compared to other UWBZ/Bluff/Aquitard wells in this area.*
- *Also detected at W-04(S) in Bluff Area.*
- *The extent of iron greater than the HCOPC screening level in the Slag Pile Area is not delineated to the east by nearby monitoring wells (i.e., the easternmost wells, PS-08 and PZ3S, have iron concentrations exceeding the HCOPC).*

***Response:*** Iron was detected at W-04(S) during one out of eight sampling events and was not detected at concentrations greater than the HCOPC screening in the three most-recent sampling

events. Similarly, iron was detected at a concentration marginally greater than the HCOPC screening level at PS-08 in one of five groundwater sampling events.

**Illinois EPA Review:** *The first bullet was not addressed by the response. If the discussion of results is to be qualified as such (i.e., one HCOPC exceedance at W-04S and then not sampled again since 2009; one HCOPC exceedance at PS-08 and then not sampled again since 2007), the revised text should include such a statement.*

**Review Response:** The text for the iron discussion under Section 5.3.3.1 will be edited as follows:

#### Iron

Iron was detected greater than the HCOPC screening level at the following locations:

- Bluff Area: Iron was detected greater than the HCOPC screening level at HH-03, HH-03B, HH-04 and W-04(S). At W-04(S), iron was detected greater than the HCOPC screening level during one of eight sampling events in August 2007 but was not detected greater than the HCOPC screening level in the subsequent three sampling events from July 2008 through April 2009.
- Eastern Area: Iron was detected greater than the HCOPC screening level at W-13(S) during the Phase I and Phase II RIs.
- Lithopone Ridges Area: Iron was detected greater than the HCOPC screening level at PS-16, PZ-06(S), and MW-41U in the Lithopone Ridges Area. Iron was detected greater than the screening level at PZ-06(S) during one of four sampling events (i.e., in June 2008) but was not detected greater than the screening level in the subsequent two sampling events in January and April 2009. Iron was detected greater than the HCOPC screening level at MW-41U during the first two Phase II RI sampling events in November 2007 and June 2008, but was not detected greater than the screening level in the last two sampling events in January and April 2009.
- Slag Pile Area: Iron was detected greater than the HCOPC screening level at HS-04(S), HS-05(S), HS-06(S), PS-08, PZ-01(S)R, PZ-02(S), PZ-03(S), MW-35U, and W-11(S). Iron was detected greater than the screening level during two of eight sampling events at HS-06(S) but was not detected above the screening level during the last three sampling events from June 2008 through April 2009. Iron at PS-08 was detected greater than the screening level during one of five sampling events, so it was not sampled again after August 2007. Iron at PZ-01(S)R was detected greater than the screening level during one of four sampling events (i.e., in June-July 2008), but was not detected above the screening level in the subsequent two sampling events in January and April 2009. At MW-35U, iron was detected greater than the screening level during one of four sampling events in June 2008 but was not detected above the screening level in the subsequent two sampling events in January and April 2009.
- UPSEA: Iron was detected greater than the HCOPC screening level at HS-08(S), HS-09(S), HS-11(S), MW-29U, MW-39U, W-18(S), and W-19(S). In HS-08(S), iron was detected greater than the screening level during the four Phase I RI sampling events, but was not detected greater than the screening level during the four Phase II RI sampling events from August 2007 through April 2009. Iron was detected greater than the screening level at MW-29U during the first quarterly Phase II RI sampling event in November 2007 but was not detected greater than the screening level in the subsequent three sampling events from July 2008 through April 2009.

As shown on Figure W-4 and in Table 5-10, the highest concentrations of iron measured in the UWBZ during the Phase II RI were detected at W-13(S) located in the Eastern Area; W-11(S), HS-04(S), and HS-05(S) in the eastern portion of the Slag Pile Area; HS-09(S) and HS-11(S) in the UPSEA; and MW-41U and PS-16 in the Lithopone Ridges Area. The highest iron concentration measured in the UWBZ during the Phase II RI was 251,000 µg/L at W-11(S) in June 2008. Iron was also detected greater than the HCOPC screening level at upgradient Bluff

Undifferentiated monitoring wells HH-03, HH-03B, W-04(S), and HH-05 with the highest concentration of 16,400 µg/L detected at HH-03 in August 2007. The extent of iron greater than the HCOPC screening level of 5,000 µg/L in the Lithopone Ridges Area and Eastern Area is delineated by nearby UWBZ monitoring wells. The extent of iron greater than the HCOPC screening level in the Slag Pile Area is delineated to the north by nearby monitoring wells W-07(S) and HS-01(S) and the physical limit of the UWBZ. The extent of iron greater than the HCOPC screening level east of the Slag Pile Area is delineated by the physical limit of the UWBZ. The western extent of iron greater than the HCOPC screening level is delineated by W-09(S), PZ-04(S)R, and the physical limit of the UWBZ. The downgradient extent of iron greater than the HCOPC screening level extends to the southern edge of the UPSEA east and west of the settling ponds. The eastern extent of iron in the UPSEA is delineated by MW-26U and the western extent west of W-18(S) is delineated by the physical limit of the UWBZ. With the exception of W-11(S), the iron concentrations measured during the Phase II RI are generally less than or similar to the concentrations measured in the Phase I RI. At W-11(S), the iron concentration measured during the Phase II RI was greater than the concentration measured in the Phase I RI. Based on the results of the Mann-Kendall trend test included in Appendix U for monitoring wells with eight quarters of data and at least one detection greater than the HCOPC screening level, iron in PS-16, HS-04(S), HS-05(S), HS-06(S), W-11(S), HS-11(S), W-18(S), and W-19(S) did not have a concentration trend. The iron in W-13(S), HS-08(S), and HS-09(S) showed a decreasing concentration trend.

**Comment 61 (continued):**

Ammonia:

- *Phase II ammonia detections greater than the HCOPC were also identified in the Eastern and Slag Pile Areas (i.e., PS-04 and W-11(S), respectively).*

**Response:** Ammonia was detected at a concentration greater than the HCOPC screening level at the above-referenced locations during only one out of eight sampling events in August 2007.

**Illinois EPA Review:** *If the discussion of results is to be qualified as such (i.e., one HCOPC exceedance and then not sampled again since 2009), the revised text should include such a statement.*

**Review Response:** The following text will be added: "Ammonia was detected above the HCOPC screening level at W-11(S) and PS-04 during only one of eight sampling event (i.e., in August 2007) and was not detected greater than the HCOPC screening level during three subsequent monitoring events from June 2008 through April 2009."

**Comment 61 (continued):**

Fluoride:

- *Also detected at MW-41U in the Lithopone Ridges Area.*
- *The maximum fluoride concentration in the Eastern Area was 18 mg/L at W-06(S) in January 2009.*
- *The eastern extent of fluoride is not delineated by MW-41U.*

**Response:** Acknowledged. However, fluoride at MW-41U was detected at a concentration greater than the HCOPC screening level once (January 2009) out of four sampling events. The concentration of 5.9 mg/L measured in January 2009 appears anomalous in comparison to the sampling results from the three remaining quarterly sampling events where fluoride was not detected at concentrations greater than 0.5 mg/L. Therefore, MW-41U provides delineation of the eastern extent of fluoride in the UWBZ.

**Illinois EPA Review:** *If the discussion of results is to be qualified as such (i.e., one HCOPC exceedance and then not sampled again since 2009), the revised text should identify that. If there is a reason other than "appearing" anomalous (i.e., laboratory issue), the revised text should include such a statement.*

**Review Response:** The following sentence will be added to qualify the fluoride detected at MW-41U: "Fluoride was detected at MW-41U above the screening level during one (i.e., January 2009) of four Phase II RI sampling events. The concentration of 5.9 mg/L measured in January 2009 appears anomalous in comparison to the sampling results from the three remaining quarterly sampling events where fluoride was not detected at concentrations greater than 0.5 mg/L."

**Comment 62.** Section 5.3.3.2, TOLA, pages 76-79:

*The following comments include locations where Phase II exceedances were identified on Table 5-10, but omitted from the text discussion.*

Iron:

- *Although located off-site, MW-34T is listed as a Bluff Area well in Table 5-10.*
- *The extent of iron greater than the HCOPC screening level in the TOLA is not delineated by MW-47T and MW-48T; iron was detected at a concentration exceeding the HCOPC at MW-46T in May 2011.*
- *The iron concentration at UPSEA UWBZ well HS-11(S) is similar to, not greater than the iron concentrations at TOLA wells MW-35T, HS-13(I), MW-26T, MW-28T, and MW-36T.*
- *The text states that the iron concentrations measured in UPSEA TOLA wells HS-13(I), MW-26T, MW-28T, and MW-36T are greater than the iron concentrations measured at upgradient TOLA wells HS-07(I), PZ-03(I), and MW-25T; however, TOLA well MW-35T is also an upgradient well, and has a similar iron concentration as the four UPSEA TOLA wells. Another upgradient well, W-11(I), also has iron concentrations more similar to the UPSEA TOLA wells than the iron concentrations of HS-07(I), PZ-03(I), and MW-25T. Consequently, upgradient sources for the elevated UPSEA TOLA iron concentrations do exist.*
- *Data on the assumed reducing conditions in the TOLA should be provided. If reducing conditions do exist, then pyrite in bedrock is an unlikely potential source, since pyrite is generally stable under reducing conditions.*

**Response:** The text will be revised. The reference to reducing conditions will be removed from the text.

**Illinois EPA Review:** *Acceptance of the response is pending review of the revised text which was not provided.*

**Review Response:** The revised text is as follows:

Iron

As shown on Figure W-13, the highest concentrations of iron in the TOLA are present at Eastern Area monitoring well HH-09 (111,000 µg/L in July 2008); Slag Pile Area monitoring well MW-35T (22,000 µg/L in June 2008); UPSEA monitoring wells HS-13(I) (30,200 in April 2009), MW-28T (24,000 µg/L in November 2007), MW-36T (26,200 µg/L in November 2007), and MW-26T (28,600 µg/L in April 2009); Bluff Area well MW-34T (26,700 µg/L in July 2008); and off-site well MW-51T (19,200 µg/L in February 2011) located in White City. Based on the TOLA groundwater flow direction, the source of iron detected at MW-34T and MW-51T is not the FPSA. The extent of iron greater than the HCOPC screening level in the TOLA in the Lithopone Ridges Area, Eastern Area, and Slag Pile Area is delineated to the west by HH-07, W-15(S), PS-04(I)R. The extent of iron

greater than the HCOPC screening level in the TOLA in the UPSEA is delineated to the west by MW-47T and MW-48T. Iron was detected at MW-46T, located west of MW-47T and MW-48T, greater than the HCOPC screening level during one of four monitoring events (i.e., May 2011). MW-46T is not located downgradient of monitoring wells with iron greater than the HCOPC screening level; therefore, the FPSA is not expected to be the source of iron detected at MW-46T.

The extent of iron to the east is delineated by MW-50T. Upgradient of the FPSA, iron was detected in TOLA well HH-04 at a concentration greater than the HCOPC screening level of 5,000 µg/L during three of the four groundwater monitoring events. Based on the groundwater flow direction, HH-04 is hydraulically upgradient of the FPSA. As shown in Table 5-10, the iron concentration measured at MW-35T in the Slag Pile Area is similar to the iron concentrations measured at HS-13(I), MW-26T, MW-28T, and MW-36T and UWBZ monitoring well HS-11(S) at the southern limit of the UPSEA. The iron concentrations detected at these UPSEA wells are greater than the concentrations measured in upgradient monitoring wells HS-07(I), PZ-03(I), and MW-25T and greater than the concentrations measured in UWBZ wells HS-12(S), W-19(S), and MW-26U. A Mann-Kendall analysis was performed for iron on eight TOLA wells that were sampled at least eight times (i.e., MW-33T, MW-34T, HS-07(I), PZ-04(I)/PZ-04(I)R, W-11(I), HS-13(I), MW-26T, and MW-27T. The results of the Mann-Kendall analysis are summarized in Appendix U and indicate that iron exhibits a decreasing concentration trend at MW-33T, MW-34T, and PZ-04(I)/PZ-04(I)R. No trend for iron concentrations was observed at HS-07(I), W-11(I), and MW-26T. An increasing iron concentration trend was observed at HS-13(I) and MW-27T.

**Comment 62 (continued):**

**Arsenic:**

- *Also detected at MW-21B in the Slag Pile Area, and MW-26B in the UPSEA, and MW-48B off-site; consequently, the downgradient extent of arsenic in the BOLA may not be delineated.*

**Response:** The DePue Group disagrees that the downgradient extent of arsenic in the BOLA is not delineated. Arsenic was detected at a concentration greater than the HCOPC screening level in one out of eight sampling events at downgradient well MW-26B and has not been detected at concentrations greater than the laboratory method detection limit in six of the seven most-recent groundwater sampling events. Arsenic was detected at a concentration marginally greater than the HCOPC screening level during one of four sampling events at MW-48B and was not detected at concentrations greater than the laboratory detection limit in three of the four samples analyzed, including the two most-recent sampling events in 2011. Based on these data, the downgradient extent of arsenic in the BOLA has been delineated.

**Illinois EPA Review:** *If the discussion of results is to be qualified as such, the revised text should include such a statement.*

**Review Response:** The revised discussion of arsenic in the TOLA is as follows:

**Arsenic**

As shown on Figure W-19 and Table 5-10, arsenic was detected in the BOLA greater than the HCOPC screening level of 10 µg/L at W-12D located just north of the FPSA in the Bluff Area, MW-38B in the Eastern Area; and MW-51B east of the FPSA in White City. The highest concentration of arsenic in the BOLA of 52.5 µg/L was detected at off-site monitoring well MW-51B in May 2011. In addition, arsenic was detected greater than the HCOPC screening level by 1.1 µg/L at MW-21B located in the Slag Pile Area in April 2009 (i.e., at a concentration of 11.1 µg/L as compared to the HCOPC screening level of 10 µg/L) and at off-site well MW-48B in November 2010. Arsenic at MW-48B was not detected greater than the laboratory detection limit in three of the four samples analyzed

in the table, groundwater in the Lower Aquifer tends to have a neutral pH, low levels of dissolved oxygen (as measured after field equilibration), and generally reducing conditions.

Well ID	Zone	Peat (ft)	pH	DO	ORP	Date	Comment
W-11(S)	UWBZ	7	3.9	0.0	229	June 2008	Low pH Oxidizing?
W-11(I)	TOLA	7	6.9	0.0	-63	June 2008	Neutral pH Reducing
MW-21B	BOLA	8	6.3	0.16	-132	June 2008	Neutral pH Reducing
W-19D	BOLA	10.9	6.9	0.0	-153	June 2008	Neutral pH Reducing
MW-29B	BOLA	6	6.7	0.11	-147	July 2008	Neutral pH Reducing

Monitoring wells MW-29B, MW-21B, and W-19(D) are located in areas where a relatively thick layer of peat is present. It is more likely that the source of the iron in these wells is either the peat, aquitard, or the natural aquifer materials releasing iron to groundwater due to reducing conditions in the aquifer. Leachate testing, summarized in Table 4-6 of the Preliminary Phase II RI Report, revealed that the peat, aquifer, and aquitard materials analyzed in the UPSEA can leach iron at concentrations greater than the screening level.

As shown in Table 5-10, the iron concentration measured in the BOLA at MW-50B (32,400 µg/L to 43,500 µg/L) is greater than the iron concentration measured in the TOLA at MW-50T (65.4 µg/L to 2,360 µg/L) at the southern extent of the Village of DePue east of the UPSEA. Based on the direction of groundwater flow, the sample locations with concentrations of iron detected in the BOLA in the off-site area to the east are not downgradient of OU3; therefore, OU2 may be the source of the higher iron concentrations in the BOLA in the off-site area to the east. However, the iron exceedances in the lower aquifer east of the FPSA are not consistent in all the listed wells, with some exceedances occurring in monitor wells where no exceedances of other OU2 COPCs have been observed. Additional groundwater studies are ongoing east of the FPSA and UPSEA as part of OU2 investigation activities."

**Comment 62 (continued):**

Manganese:

- *The text statement that manganese was not detected greater than the HCOPC at W-17(D), MW-40B, and MW-25B is misleading; it was detected greater than the HCOPC at each of these locations, just not since early 2009 at W-17(D) and MW-40B, and not since 2007 at MW-25B.*

Response: The text presented in the Phase II RI represents an analysis of the four most-recent rounds of groundwater sampling. Therefore, the text presented is not misleading. To clarify and to include a description of the Phase I RI data, the text will be revised as follows: "As shown on Figure W-24 and in Table 5-10, the highest concentrations of manganese in the BOLA were detected at W-12(D) in the Bluff Area and W-21(D) in the Eastern Area. Manganese has not detected greater than



the HCOPC screening level of 150 µg/L at W-17(D) at the southern extent of the Eastern Area since January 2009 and has not been detected greater than the HCOPC screening level in the last five quarterly sampling events. Manganese has not been detected greater than the HCOPC screening level at MW-40B in the Vanadium Pentoxide Catalyst Disposal Area since April 2009 and has not been detected greater than the HCOPC screening level in the last four quarterly groundwater monitoring events from July 2010 through May 2011. Manganese was detected marginally greater than the HCOPC screening level at MW-25B in the UPSEA in November 2007, but was less than the HCOPC screening level during the six subsequent sampling events from July 2008 through May 2011. Based on these results, manganese is generally present in the BOLA greater than the HCOPC screening level."

***Illinois EPA Review:*** *It is not appropriate to discuss only the four most recent rounds of data in the Phase II report. This approach disregards previous Phase I and Phase II data; data that was used to decide the locations of additional monitoring well installations, as well as whether to continue or discontinue sampling a well. Trend analysis, such as that proposed to be included in the revised report, or the discussion of trends, as presented in the response, benefits from a history of data, and should be presented in the revised report.*

**Review Response:** As outlined in the response above, a description of the Phase I RI data was proposed for incorporation into the text.

***Comment 62 (continued):***

**Ammonia:**

- *The highest concentration in an off-site well is 360 mg/L at MW-48B (only detection for this well), or more consistently at MW-51B (three detections ranging from 180 to 300 mg/L).*
- *Due to the detection at MW48B, the delineation to the east is defined by MW-46B.*

**Response:** The DePue Group disagrees regarding the ammonia delineation by MW-48B. Ammonia at MW-48B was detected at a concentration (i.e., 360 mg/L) greater than the HCOPC screening level (35 mg/l) during one of four quarterly monitoring events (i.e., in November 2010). The ammonia concentrations measured during the remaining three sampling events was less than 3 mg/L, indicating that the ammonia concentration measuring in November 2010 was anomalous. As a result, MW-47B and MW-48B appear to provide adequate locations for the delineation of ammonia to the west.

***Illinois EPA Review:*** *If there is a reason other than appearing anomalous (i.e., laboratory issue), this should be identified in the revised text. Sulfate, arsenic, and iron concentrations also exceed screening criteria during the November 2010 sampling event.*

**Review Response:** There is no reason other than that the results for these analytes from MW-48B are anomalously high as compared to the other three sampling events at MW-48B conducted as part of the Phase II RI. Therefore, no further text revisions beyond those presented in the initial response above are proposed.

***Comment 62 (continued):***

**Sulfate:**

- *The concentration of sulfate at MW-48B (2,500 mg/L) is as high as the other off-site wells cited in the text.*

**Response:** The text will be edited as follows: "Sulfate was detected at 2,500 mg/L in November 2010 at off-site well MW-48B, located west of the UPSEA, but was not detected at concentrations greater

than 130 mg/L in the three other sampling events; therefore, the sulfate detection at MW-48B in November 2010 appears to be anomalous.”

**Illinois EPA Review:** See comment above. If there is a reason other than “appearing” anomalous (i.e., laboratory issue), this should be identified in the revised text.

**Review Response:** Please see the review response above for ammonia.

**Comment 65.** Section 6.1.3, Bluff Area Groundwater, pages 83-84, Figure 6-2:

*b) During the Phase II groundwater monitoring iron and manganese were consistently detected greater than HCOPC screening levels at MW-34T and these metals are also consistently elevated or exceed the HCOPC screening level at MW-32T, and MW-33T. The text should provide an interpretation of the source for these metals.*

**Response:** The fourth paragraph under 6.1.3 will be revised as follows: “During the Phase II RI groundwater monitoring, iron and/or manganese were consistently detected greater than HCOPC screening levels or at elevated concentrations in the TOLA at MW-32T, MW-33T, and MW-34T, located north of the Lithopone Ridges Area and the Vanadium Pentoxide Catalyst Disposal Area; and the Slag Pile Area and BOLA monitoring wells W-02(D) and W-12(D). The presence of Iron in the Lower Aquifer in the bluff area are not consistent in the wells monitored as part of OU2 with some exceedances occurring in monitoring wells where no exceedances of other OU2 COPCs have been observed. Therefore, the iron detected in the Lower Aquifer in the Bluff Area is not likely associated with OU2 and may represent ambient conditions in the Lower Aquifer. As shown on the distribution maps provided on Figures W-15 and W-24, manganese is present in the Lower Aquifer at levels greater than the HCOPC screening level throughout the study area and the pattern of exceedances is dissimilar from the other OU3 compounds of concern such as zinc and lead indicating that lower concentrations (i.e., <1,000 ug/L) of manganese detected in some OU3 monitoring wells may represent ambient conditions in the Lower Aquifer.”

**Illinois EPA Review:** The response appears to state that the absence of other OU2 COPCs in TOLA wells MW-32T, MW-33T, and MW-34T indicates that the iron present at elevated or HCOPC exceedance concentrations in these three TOLA wells is not likely associated with OU2 and may represent ambient conditions in the Lower Aquifer. A review of the data indicates that this is not the case for MW-34T where, besides iron and manganese, other OU2 COPCs (ammonia and sulfate) are also present at elevated/HCOPC exceedance concentrations. This would suggest an OU2 source for the iron at MW-34T. Iron concentrations are generally below the HCOPC screening level at MW-32T and MW-33T; however, they are elevated compared to MW-31T, suggesting that these concentrations do not represent ambient conditions. Iron impacts are documented in the Lower Aquifer at OU2 (iron concentrations at GYP-MW-8LS consistently exceed the 5.0 mg/L assessment level). Based on the flow regime from south of the gypstack through the bluff area, an OU2 source may also be likely for the elevated iron concentrations present at MW-32T and MW-33T, and exceedances for iron at MW-34T.

The response states that because the pattern of manganese exceedances is dissimilar from other OU3 compounds such as zinc and lead, that the lower concentrations (i.e., <1,000 ug/L) of manganese detected in some OU3 monitoring wells may represent ambient conditions in the Lower Aquifer. This statement is essentially copied from the OU2 2012 report (second full paragraph on page 201), but applied to the observations at OU3, and then used to suggest that the presence of manganese at MW-32T, MW-33T, and MW-34T likely represents background conditions. A review of the Illinois State Water Survey paper used as a reference for background manganese concentrations in the 2012 OU2 report indicates that Bureau County manganese concentrations in the Sankoty Sand range from 0.079 mg/L to 0.383 mg/L (average of 0.18 mg/L). Consequently, defining lower

*concentrations as <1,000 ug/L of manganese as ambient conditions is not appropriate. All of the manganese concentrations at MW-34T exceed the high end of the Sankoty range concentration by a substantial margin. Based on the flow regime from south of the gypstack through the bluff area, an OU2 source is likely for the manganese present at MW-34T.*

**Review Response:** Additional investigations are being completed to evaluate groundwater conditions associated with OU2. Conclusions regarding the source of iron and manganese at these locations will be incorporated in the associated OU2 investigation reports.

**Comment 65 (continued):**

*d) What is the source of arsenic, iron and manganese concentrations that consistently exceed the HCOPC screening level in BOLA well W-12(D), and the source of iron and manganese in BOLA well W-2(D)?*

**Response:** Based on the groundwater flow direction and concentration of arsenic in upgradient monitoring wells in the Lower Aquifer, the source of these compounds at W-12(D) is unknown. However, the arsenic concentration at W-12(D) is less than the Class I standard of 50 µg/L listed in Title 35 of the Illinois Administrative Code, Part 620, Section 620.410 entitled "Groundwater Quality Standards for Class I: Potable Resource Groundwater." See response 65b regarding iron and manganese.

**Illinois EPA Review:** *a) The response to comment fails to address the iron and manganese concentrations at W-12(D) or W-2(D).*

**Review Response:** As stated in the initial response, the response regarding iron and manganese was presented in the response to comment 65b. Additional investigations are being completed to evaluate groundwater conditions associated with OU2. Conclusions regarding the source of iron and manganese at these locations will be incorporated in the associated OU2 investigation reports.

**Illinois EPA Review:** *b) The source of arsenic resulting in concentrations exceeding HCOPC screening levels at W-12(D) is unknown; therefore the text should be revised and should not say "...the source of arsenic at W-12(D)...do not appear to be from historic activities at the FPSA." Neither the OU2 nor the OU3 investigations clearly define the Lower Aquifer flow regime in this area immediately west of W-12(D).*

*Illinois' groundwater quality standards have been recently revised (October 2012), including the Class 1 arsenic standard, which has decreased to 10 ug/L. This value should be adopted as the appropriate screening criterion for arsenic in groundwater. (A groundwater standard for vanadium has been added; 0.049 mg/L.)*

**Review Response:** Table 5-10 compares the arsenic groundwater results of 10 µg/l and the vanadium groundwater results to 49 µg/L. The text will be edited to indicate that the source of arsenic at W-12(D) is unknown; however, arsenic is more mobile under reducing conditions. Reducing conditions were measured at W-12(D) (e.g., ORP measurements of -92 mV, 12 mV, -130 mV, and -96 mV, respectively) during the four Phase II RI quarterly sampling events. Consequently, the arsenic identified at W-12(D) may be dissolved from the aquifer materials. Arsenic in the BOLA surrounding W-12(D) (i.e., HH-06, W-02(D), MW-41B, W-13(D)) and the BOLA wells along the southern extent of the FPSA downgradient of W-12(D) is generally not detected greater than the laboratory method detection limit; therefore, the arsenic detected greater than the HCOPC screening level at W-12(D) is limited to the area around W-12(D) and does not extend beyond the limits of the FPSA.

**Comment 66.** Section 6.2.3, *Lithopone Area Non-Native Materials*, page 85:

*a) See comment on Section 4.2.1.1. The fill material tested for paste pH, sulfur speciation and NAG appear to be cover material soils collected from one location, and are not representative of the types of fill material present in the Lithopone Ridges areas that would be expected to generate acid. The acid generating capacity in this area is unknown; however given the types of materials that remain uncovered in this area, it should be assumed that acids and leached metals are being generated. The text should be revised to this effect.*

Response: See response to comment No. 24.

**Illinois EPA Review:** See the review of response to comment 24a).

Review Response: See review response 24a.

**Comment 67.** Section 6.2.4, *Lithopone Area Native Materials*, page 84: *The text says that based on hydraulic conductivity and geochemistry testing the aquitard and peat are effective in sequestering metals. This is contradicted in Section 4.2.1.2 where the data show that SRB activity is non-existent, the TOC concentrations and CEC (even for the peat) are low, and there are no sulfides (AVS) to bind metals. Figure 4-11 shows that there are significant portions of the area, particularly where exposed waste material exists, where the peat is non-existent; and Figure 4-7 shows portions of the area with a thickness of aquitard less than 3 feet. Sequential Batch Testing of the aquitard material from the Lithopone Area suggests the potential capacity to leach metals, with the exception of cadmium and zinc. However, the sequestration capacity for cadmium and zinc may be quickly exhausted. Sequestration capacity of the peat, where present, for cadmium, manganese and zinc is a little better, but the capacity for sequestering other metals is unknown. Despite hydraulic conductivities in the  $1 \times 10^{-8}$  to  $1 \times 10^{-6}$  range measured in some portions of the aquitard, elevated concentrations of cadmium, cobalt, lead, iron, manganese, nickel, zinc, and sulfate are found in the Lower Aquifer at TOLA well MW-30T.*

*This section of the text should be revised to describe the actual data and how it affects the interpretation of the distribution and migration of contaminants.*

Response: The text for Section 6.2.4 will be revised as follows: "Native materials in the Lithopone Ridges Area consist of peat, the aquitard, and the Lower Aquifer. The limit of the extent of the peat is shown on Figure 4-11 and indicates that peat is not present throughout the entire Lithopone Ridges Area. Where present the thickness of the Peat ranges from 0.5 to 5 feet thick. As shown on Figure 4-7 and in Table 4-2C, the thickness of the aquitard in the Lithopone Ridges Area, where fully penetrated by the borings, ranges from 3 feet thick at SB-31 to 25 feet thick at SB-28. The hydraulic conductivity of the aquitard in the Lithopone Ridges Area ranges from  $2.74 \times 10^{-6}$  cm/sec to  $4.61 \times 10^{-8}$  cm/sec. Based on the thickness and low hydraulic conductivity of the aquitard, it is expected that the aquitard is effective at minimizing the interaction between the UWBZ and the Lower Aquifer. However, based on the downward vertical gradient observed at well pairs PS-14/HH-08 and MW-41U/MW-41B and the presence of elevated concentrations of COPCs at MW-30T, COPCs have migrated from the UWBZ to the Lower Aquifer.

The results of the CEC, TOC, AVS, and sulfate reducing bacteria geochemical testing in the Lithopone Ridges Area indicate that native materials are not effective at sequestering metals. The results of the sequential batch testing indicated that the peat has the capability of sequestering cadmium, manganese, and zinc. The sequential batch test results of the aquitard and the lower aquifer indicate that these materials may have the potential to sequester cadmium and zinc, but leach manganese, aluminum, barium, iron, lead, and vanadium; however, manganese, aluminum, barium, iron, lead, and vanadium were not detected in the supernatant water."

**Illinois EPA Review:** *The revision should state that batch tests indicate potential sequestration of cadmium and zinc by the aquitard material is likely quickly exhausted. Also the revision should be changed to say that the aquitard is effective at reducing the interaction between UWBZ and the Lower Aquifer, instead of “minimizing the interaction...”*

**Review Response:** The term “minimizing” will be revised to “reducing”. The discussion of the sequential batch testing results will be edited to read: “The sequential batch test results of the silty clay and the lower aquifer indicate that these materials may have the potential to sequester cadmium and zinc and the lower aquifer may also sequester manganese; however, the sequestration capacity of the silty clay for cadmium and zinc appeared to be exhausted at the end of the 10 day test.”

**Comment 68.** *Section 6.2.5, Lithopone Area Groundwater, page 85-86:*

a) *Illinois EPA agrees that metal concentrations in the Lower Aquifer are less than measured in the UWBZ, but it is not clear why the text focuses on the fact that lead was not detected greater than the HCOPC screening level in the TOLA and ammonia was detected in only one event, when cadmium, iron, manganese, zinc, and sulfate DO exceed their screening levels in the TOLA, and cobalt, lead, and nickel are elevated above upgradient (HH-08R and MW-32T) concentrations. The discussion should focus on how and where these contaminants migrated into the Lower Aquifer, and whether or not there is a trend in the concentrations signaling the long-term stability, expansion, or contraction of impacts to the Lower Aquifer as they migrate into the Eastern Area and Slag Pile Area.*

b) *Additional metals not listed also have elevated concentrations (i.e., exceeding HCOPCs) in the UWBZ. The text should either list them all, or qualify the ones listed.*

c) *Sulfate greater than the HCOPC screening level in the TOLA is found in MW-30, W-20(I) and PZ-05(S).*

d) *The role of the North Ditch should be clarified. It is stated that the North Ditch receives surface water and groundwater from the UWBZ, but Section 6.3.1 indicates the North Ditch is usually dry except during significant rain events.*

**Response:** a, b, and c) The text for Section 6.2.5 will be edited as follows:

**UWBZ** – In the UWBZ, arsenic, cadmium, cobalt, copper, iron, lead, manganese, mercury, nickel, thallium, zinc, ammonia, fluoride, nitrate/nitrite, nitrite, and sulfate were detected greater than the HCOPC screening level during at least one sampling event during the Phase I and Phase II RI's. Downward vertical hydraulic gradients are present between the UWBZ and the Lower Aquifer in the Lithopone Ridges Area resulting in some UWBZ groundwater flowing through the aquitard and recharging the Lower Aquifer as shown on Figure 6-2. The most-likely location for the downward migration of COPCs from the UWBZ to the Lower Aquifer is near MW-30T and SB-31 where the aquitard is 5 feet thick or less. As indicated by the sequential batch testing results, the peat and clays of the aquitard in the Lithopone Ridges Area sequestered cadmium, zinc, and to a lesser extent manganese as groundwater passes through the unit resulting in appreciably lower concentrations of HCOPCs in the Lower Aquifer.

**Illinois EPA Review:** *Response should state that batch testing indicates sequestration is exhausted over time.*

**Review Response:** The following sentence will be added to the end of the UWBZ section: “As expected, the results of the sequential batch testing indicate that sequestration is exhausted over

time for those metals with an "E" qualifier in Table 4-5B." In addition, based on the summary presented in Table 4-5B, copper will be added as an analyte that is sequestered by the peat.

Response (to comment 68 a, b, and c continued):

**Lower Aquifer** – In the Lower Aquifer, cadmium [MW-30T and W-20(I)], iron (MW-30T and MW41B), manganese [MW-30T, W-20(I), and MW-41B], zinc (MW-30T), ammonia [W-20(I) in August 2007], nitrate-nitrite [PZ-05(S)], nitrite [one event at PZ-05(S) and W-20(I)], and sulfate [PZ-05(S), MW-30T, and W-20(I)] were detected greater than the HCOPC screening level during at least one sampling event during the Phase I and Phase II RI. The remaining HCOPCs were not detected in the Lower Aquifer greater than the HCOPC screening level. Based on the concentration of these constituents in the UWBZ, the downward vertical gradient, and the concentrations in upgradient monitoring wells in the Lower Aquifer, the non-native material is the source of cadmium, zinc, manganese and sulfate (western portion of Lithopone Ridges Area) in the Lower Aquifer in the Lithopone Ridges Area. Using the same rationale, the presence of iron in the Lower Aquifer in the Lithopone Ridges Area does not appear to be non-native material and the concentrations detected at HH-08R and MW-30T are likely ambient conditions in the Lower Aquifer. OU2 is the likely source of sulfate in the TOLA at PZ-05(S). The source of nitrate-nitrite at PZ-05(S) is not known.

**Illinois EPA Review:** *a) The statement, "Using the same rationale, the presence of iron in the Lower Aquifer in the Lithopone Ridges Area does not appear to be non-native material and the concentrations detected at HH-08R and MW-30T are likely ambient conditions in the Lower Aquifer" is not accurate and should be removed from the revised text. A comparison of the iron concentrations in Bluff Area well MW-32T (approximate average 3,000 ug/L) to those in Lithopone Ridges Area wells HH-08R (approximate average 6,000 ug/L) and MW-30T (approximate average 7,000 ug/L) shows an increase and consequently an impact to the TOLA from the material in the Lithopone Ridges Area. The proposed revision to the text should be changed to reflect this.*

**Review Response:** The tables below shows the concentrations of iron as well as the associated field measured parameters of oxidation-reduction potential (ORP), dissolved oxygen (DO), and pH for the four quarters of monitoring at Bluff Area well MW-32T, and Lithopone Ridges Area wells HH-08R and MW-30T. As shown in the tables, the background concentration of iron at MW-23T ranged from 2,520 µg/L to 18,900 µg/L during the quarterly sampling. The range of iron detections at HH-08R and MW-30T are within this background range. The DO and ORP of the Lower Aquifer are variable, but generally low, consistent with reducing conditions. In addition, lower concentrations of iron were detected in the UWBZ in the Lithopone Ridges Area than the concentrations measured in the Lower Aquifer, which also indicates that the Lithopone Ridges Area does not appear to be the source of iron in the Lower Aquifer.



TOLA Well	Area	August and November 2007				June-July 2008			
		Fe (ug/L)	ORP (mV)	DO (mg/L)	pH (SU)	Fe (ug/L)	ORP (mV)	DO (mg/L)	pH (SU)
MW-32T	Bluff	18,900	-188	0	6.41	3,610	-83	0	6.91
HH-08R	Lithopone	5,080	-112	0	7.2	5,850	-136	0	6.59
MW-30T	Lithopone	4,850	-37	0	6.36	7,380	24	0.3	5.74
HH-09	Eastern	71,300	-40	0	6	111,000	66	4	6
TOLA Well	Area	January 2009				April 2009			
		Fe (ug/L)	ORP (mV)	DO (mg/L)	pH (SU)	Fe (ug/L)	ORP (mV)	DO (mg/L)	pH (SU)
MW-32T	Bluff	2,520	-142	0	6.78	3,590	-94	1.69	6.61
HH-08R	Lithopone	6,060	-140	0	9.55	7,140	140	2.2	7.06
MW-30T	Lithopone	7,480	6	1.95	6.36	6,340	201	1.84	6.41
HH-09	Eastern	110,000	83	0	6	91,800	34	1.14	6.14

Consequently, no changes to the text proposed in the initial response are necessary.

**Comment 70.** *Section 6.3.1, Slag Pile Surface Water, page 86: Surface water flow on the western end of the top of the Slag Pile goes to a different drain (i.e., western drain) than the surface water flow on the eastern end that is captured by the two eastern surface inlets. The text states that the flow from the western drain is piped to the base of the Slag Pile. Does this water drain on the ground surface to be intercepted by inlets between the Slag Pile and Marquette Street then off to the IWTP? Figure 6-1A should show the entire drainage route for western drain flow.*

**Response:** The following sentence will be added to the last paragraph of Section 6.3.1: "Water from the western drain infiltrates into the ground, flows south along the base of the slag pile, and could flow into the Division Street Ditch during very heavy rain." Figure 6-1A will be revised with this information.

**Illinois EPA Review:** *The revised report should document the observations that were made during precipitation events that led to the statement, "...could flow into the Division Street Ditch during very heavy rain." Has this been observed, or is it the intervening topography that makes this an assumption? What amount of precipitation is necessary before flow is observed in this Ditch?*

**Review Response:** Based on the data obtained during the surface water run-off program, there is no evidence that significant surface water run-off is leaving the site. The following text will be incorporated:

"Water from the western drain infiltrates into the ground, flows south along the base of the slag pile, and could flow into the Division Street Ditch during very heavy rain. However, as outlined in the March 23, 2007 letter to IEPA project manager Richard Lange, which was approved on June 27, 2007, during the three years when the surface water run-off program was implemented, only one sampling event (defined as a rainfall event of 1-inch or more that occurs at least 72 hours after a previous rainfall event during working hours) occurred and observations along the south and west of

the perimeter of the Site showed no sign of surface water flowing off the Site. The letter concluded that there is no evidence that significant surface water run-off is leaving the Site."

**Comment 73.** *Section 6.3.3, Slag Pile Groundwater, pages 88-89: The paragraph from the text that summarizes the IRM wall evaluation is reproduced here, followed by specific comments:*

*Based on the results of the IRM wall evaluation presented in Section 4, the IRM Wall and Interceptor System intercepts and/or treats much of the groundwater that passes through the system and pumps the intercepted water to the IWTP for treatment. Therefore, the chemical and physical processes that contribute to the reduction in COPCs in the UWBZ downgradient of the Slag Pile Area are treatment by the IRM Wall/Interceptor Trench System, sequestration of inorganic parameters by the peat/aquitard underlying the UWBZ, and dilution.*

*a) A clarification should be included in the text. The interceptor system is a near-surface component that only collects groundwater when the water table rises to within two feet of the ground surface, or to control surface runoff and ponding. It has no consistent contact with groundwater flowing through the UWBZ, and its contribution to treatment (other than as a conduit for treatment in the IWTP) is zero.*

**Response:** The following text will be added: "The shallow interceptor trench system collects groundwater when the water table rises to within approximately 2 feet of ground surface and provides a contribution to treatment of groundwater only during high groundwater levels. The north and south interceptor trench extensions were installed to approximately 3 to 4 feet below ground surface and contribute to groundwater treatment when the water level rises above the interceptor trench extensions. During the IRM wall investigation, the depth to groundwater at TW-2U, located adjacent to the south interceptor trench system extension was slightly less than 2 feet below ground surface indicating that the south interceptor trench extension was likely intercepting shallow groundwater; therefore, providing some contribution to groundwater treatment."

**Illinois EPA Review:** *Within this text revision a distinction needs to be made between groundwater treatment (i.e., in-situ as purportedly made by IRM material, or ex-situ by the IWTP) and groundwater collection as performed by the interceptor trench system. The interceptors provide collection of groundwater for ex-situ treatment at the IWTP.*

**Review Response:** The text will be revised to read: "The shallow interceptor trench system collects groundwater when the water table rises to within approximately 2 feet of ground surface and provides a contribution to treatment of groundwater by interception and ex-situ treatment at the IWTP only during high groundwater levels. The north and south interceptor trench extensions were installed to approximately 3 to 4 feet below ground surface and contribute to groundwater treatment by interception and ex-situ treatment at the IWTP when the water level rises above the interceptor trench extensions. During the IRM wall investigation, the depth to groundwater at TW-2U, located adjacent to the south interceptor trench system extension was slightly less than 2 feet below ground surface indicating that the south interceptor trench extension was likely intercepting shallow groundwater; therefore, providing some contribution to groundwater treatment."

**Comment 73 b)** *In Transect 1 and Transect 3 only the first 2 wells that straddle the North IRM Wall provide any insight into the function or effectiveness of the IRM to treat metals. The remaining wells in these two transects do not come in contact with the Center or South IRM walls or the subsurface drains associated with them. In Transect 1 the metals concentrations in the downgradient well remained relatively the same (within the range of sample and laboratory variability), or increased compared to concentrations in the well upgradient of the IRM wall. A similar result was observed at Transect 3. This suggests that the IRM has limited to no treatment capacity at these locations. The*

*geochemical or physical mechanism responsible for the overall decrease in concentrations observed across the entire length of these transects remains unexplained by the DePue Group.*

**Response:** The geochemical and physical mechanisms responsible for the overall decreases along Transects 1 and 3 likely include adsorption, precipitation, advection, dispersion, reduction, and cation exchange.

**Illinois EPA Review:** *This is an overly broad statement that doesn't address the issue of the performance of the IRM material to treat groundwater downgradient of the Slag Pile. There is little to no treatment provided by the IRM. Will all these mechanisms be incorporated into the text? Are these different than the mechanisms effecting Transect 2?*

**Review Response:** Based on Transects 1 and 3, the North IRM Wall does not appear to be effective at treating groundwater; however, as mentioned in the responses to the various parts of Comment 42, the evaluation of effectiveness of the North IRM wall is difficult because the wells upgradient and downgradient of the walls are screened within slag and fill. The mechanisms listed in the response will be incorporated into the text, including the text for Transect 2 consistent with the edits proposed for the various parts of Comment 42.

**Comment 73 c)** *The southern-most wells in each of the 3 transects appear to be screened in the fill material placed for railroad construction, and have little relationship to the Slag Pile UWBZ. Although it's good that groundwater here does not contain elevated concentrations of COPCs, these results probably have little bearing on the IRM evaluation.*

**Response:** The southern-most wells in the IRM transects are screened in different material than the material that is present in the UWBZ in the Slag Pile Area; however, the monitoring wells are installed within the UWBZ downgradient of the Slag Pile Area and show decreases in COPC concentrations and help define the downgradient extent of impact from the Slag Pile Area. The text will be edited such that data from the southern-most wells along the transects are not included in the discussion of the effectiveness of the IRM Wall/Interceptor Trench System, but are included in the evaluation of groundwater conditions downgradient of the Slag Pile Area.

**Illinois EPA Review:** *Illinois EPA concurs that the wells downgradient help define the extent of impact from the Slag Pile area. For Transects 1 and 3 particularly, the wells south of the FPSA fence line are installed predominantly in the peat, clay, or general fill material. Certainly this has some impact on the metals concentrations measured at these locations. This should be taken into account when evaluating the transect results and discussion of the effectiveness of the IRM Wall/Interceptor Trench System. Decreases in metals concentrations that are observed in wells screened in peat and organic clay should not be attributed to "effective treatment" by the IRM Wall/Interceptor Trench System*

**Review Response:** As outlined in the response above, the text will be edited such that data from the southern-most wells along the transects are not included in the discussion of the effectiveness of the IRM Wall/Interceptor Trench System, but are included in the evaluation of groundwater conditions downgradient of the Slag Pile Area.

**Comment 73 d)** *At Transect 2, the North IRM wall appears to have some capacity to reduce metals. However the Center and South IRM walls appear to have little to no effect on concentrations. Screening levels for most metals are still exceeded in well HS-09(S), located upgradient of the railroad fill material. Fortunately this water is captured by the South IRM Wall underdrain, and to a lesser extent the Center IRM Wall underdrain.*

**Response:** The DePue Group disagrees that the Center and South IRM walls have little to no effect on concentrations. The Center IRM wall has an effect on copper concentrations noted by copper concentrations ranging from 57,400 ug/L to 66,300 ug/L at PS-17 located upgradient of the center IRM wall to less than 20,000 ug/L at HS-08(S) downgradient of the center IRM wall. Although some COPCs are present at HS-09(S) at concentrations greater than the HCOPC screening level, the concentrations of several compounds including cadmium, cobalt, copper, lead, manganese, nickel, silver, and zinc show large concentration decreases downgradient of the South IRM wall.

**Illinois EPA Review:** See Comment 42-e4. A link has not been definitively established between the presence of IRM material and any major decrease in concentrations. Well PS-17 is screened in residue and HS-08(S) is screened in Fill sand/silt and native silt, and the Center IRM Wall underdrain sits between both wells. The combination of the difference in lithology and the capture of some of the metals contaminated water by the underdrain likely accounts for the differences observed in copper concentrations. Major decreases south of the South IRM Wall are likely due to a combination of wells screened in peat/organic clay, increased pH >6 and stronger reducing conditions, probably unrelated to the IRM material itself. To clarify the effectiveness evaluation, another distinction may need to be made between IRM walls that have underdrains (that remove some of the contaminated groundwater) versus those that don't (i.e., the North IRM wall).

**Review Response:** Based on the boring log for HS-08S, the well is screened within fill described as grayish black fine to medium sand with trace fines and gravel. The well screen for PS-17 is screened within brown/black fine to coarse grained "residue" with a component of gravel at approximately 7 feet bgs. The lithologies at these locations were described by different geologists. The descriptions of the materials encountered are comparable. One uses the term "residue" to describe the black sand and one uses "fill" to describe the black sand. The two wells are screened in the same material; therefore, the supposed differences in lithology between PS-17 and HS-08(S) outlined in the IEPA Review would not account for the observed analytical differences between the two locations. The analytical results along the transects are similar prior to and after shutdown of the underdrains, indicating that treatment still occurred across the wall while the underdrains were closed.

**Comment 73 e)** Sequestration of inorganic parameters by the peat/aquitard underlying the UWBZ; It is assumed that this refers to the CEC capacity of the peat. Since CEC is the degree to which soil, in this case peat, can adsorb cations, what is the capacity for this to continue/ why haven't the majority of exchange sites been utilized already?

**Response:** Cation exchange is a dynamic process and the cation exchange capacity of a substance will fluctuate as a function of the chemical composition of the groundwater flowing through it.

**Illinois EPA Review:** While this is true, it should also be recognized that some metals have higher affinities for adsorption than others. This is dependent on the ionic potential – for ions with a similar size, the one with the lower charge will adsorb first; for ions of a similar charge, the one with the larger radius will adsorb first. For other metals, the electron configuration is more important than the ionic radius (e.g., the adsorption of copper > nickel > cobalt > iron > manganese). For all cations, the fraction adsorbed increases with pH. Consequently, there are some restrictions on the reversibility of cation exchange.

**Review Response:** The text will be revised to read: "Cation exchange is a dynamic process, which is not always reversible, and the cation exchange capacity of a substance will fluctuate as a function of the chemical composition of the groundwater flowing through it."

**Comment 73 f)** Dilution has not been previously mentioned in the report. What is the evidence that dilution plays a role in the reduction of COPCs? What is the source of this dilution?

**Response:** In the environment, it is not possible to define the contribution of each process that results in a decrease in chemical concentration. Dilution refers to the decrease in chemical concentration caused by the input of additional water (rainwater, snowmelt, lower concentration groundwater).

**Illinois EPA Review:** Based on the configuration of the system it appears that the input of additional water would be restricted to the area between the toe of the Slag Pile and the fence line north of Marquette Street. South of the fence line the surface is covered by sidewalk, asphalt, or crushed gravel underlain by a PVC liner for the interceptor system that would prohibit the input of water and subsequent dilution. Part of the intent of the original comment was to elicit a description of these conditions. Furthermore, the data available for the area susceptible to additional water input does not demonstrate significant concentration decreases, suggesting that dilution is probably relatively unimportant. It's also possible that input of additional water may raise the water table bringing water in contact with shallower Slag Pile material, thereby offsetting any dilution effects, or potentially increasing contaminant concentrations.

**Review Response:** Dilution is no longer mentioned in the report text and has been replaced with advection, dispersion, reduction, precipitation, adsorption, and cation exchange.

**Comment 73 g)** The final bullet for Transect 1 states that the concentration of silver and arsenic were reduced from >500 ug/L to non-detect. Per Section 4.7.6 of the report, the September 2010 analysis for silver used the ICP/MS method instead of the ICP method, resulting in elevated silver results. As such, the silver data was not discussed in that evaluation. Consequently, silver data cannot be used in this summary evaluation to support the IRM Wall/Interceptor Trench System effectiveness. Also, concentrations of arsenic in Transect 1 were 140 ug/L and less.

**Response:** The final bullet below Transect 1 will be revised as follows: "The concentration of arsenic was reduced from 140 µg/L at TW-02U to non-detect at TW-04U prior to trench shutdown."

**Illinois EPA Review:** Per the response to comment 73c), "The text will be edited such that data from the southern-most wells along the transects are not included in the discussion of the effectiveness of the IRM Wall/Interceptor Trench System, but are included in the evaluation of groundwater conditions downgradient of the Slag Pile Area." Consequently, the statement cannot include TW-04U, and the evidence for arsenic reduction should include a comparison to TW-03U instead. The revision should read: "The concentration of arsenic decreased from 140 ug/L at TW-02U to 27.6 ug/L at TW-03U prior to trench shutdown."

**Review Response:** The final bullet below Transect 1 will be revised as follows:

- "The concentration of arsenic was reduced from 140 µg/L at TW-02U to 27.6 ug/L at TW-03U prior to trench shutdown."

**Comment 76.** Section 6.4.3, UPSEA Groundwater, pages 90-91:

b) Although below the HCOPC screening levels, elevated concentrations of zinc and nickel are detected in TOLA/BOLA wells MW-27T and W-18(D). What is the source of these metals in the Lower Aquifer?

**Response:** The zinc concentrations at MW-27T and W-18(D) are well below the HCOPC screening level and the nickel concentrations are non-detect or approximately 10 percent of the HCOPC screening level.

**Illinois EPA Review:** The comment was "What is the source of these metals in the Lower Aquifer?" not "Do these metals exceed the screening level". The response does not address the comment.

*The source of elevated concentrations of nickel and zinc in MW-27T and W-18D is apparently from the Slag Pile Area where upgradient well PZ-04I(R) results show nickel and zinc concentrations above the screening criteria. In this area the aquitard is absent and there is a downward vertical gradient between the UWBZ and the TOLA.*

**Review Response:** The following text will be added to Section 6.4.3: "Zinc and nickel are detected in TOLA/BOLA wells MW-27T and W-18(D) at concentrations less than the HCOPC screening levels. Based on the presence of these metals in the UWBZ, the absence of the aquitard, and the presence of a downward vertical gradient between the UWBZ and the Lower Aquifer in the vicinity of PZ-04(I)R, the Slag Pile Area is the apparent source of nickel and zinc in the Lower Aquifer."

**Comment 76 c)** *What is the supporting evidence for denitrification in the Lower Aquifer? What organic matter is found in the TOLA and BOLA? All the OU2 data has been collected and is available. There appears to be no reason to delay the evaluation of this issue.*

**Response:** The discussion of denitrification will be removed from the text although it may be occurring. OU2 will be identified as the source of the ammonia in the Lower Aquifer.

**Illinois EPA Review:** Response is acceptable.

*Also the report text states the following: "The geochemical testing performed on the peat and aquitard in the UPSEA indicates that the peat and the aquitard have the ability to reduce metals and sulfate concentrations by chemical processes such as CEC that results in appreciably lower concentrations of HCOPCs in the Lower Aquifer." Sulfate is an anion and is not subject to absorption on negatively charged soil particles as part of the CEC process. This sentence should be revised in the text.*

**Review Response:** The text will be revised to read: "The geochemical testing performed on the peat and aquitard in the UPSEA indicates that the peat and the aquitard have the ability to reduce metals and sulfate concentrations. Chemical processes, such as CEC, result in appreciably lower concentrations of metal HCOPCs in the Lower Aquifer. Reduction processes may be responsible for the observed decrease in sulfate concentrations."

**Comment 76 d)** *This section should discuss the source and fate and transport of water in seeps N003, 004, 005, and 006.*

**Response:** This section will be edited as follows: "A comparison of the groundwater concentrations upgradient of UPSEA seeps N003, N004, and N005 indicates that the Lower Aquifer is the likely source of the UPSEA seeps as follows:

- N003: A comparison of the concentration of arsenic, cadmium, manganese, nickel, zinc, ammonia, and sulfate between UPSEA seep N003 and nearby UWBZ well HS-11S and TOLA well MW-28T indicates that the concentration of these compounds detected at N003 are more similar to the concentrations detected in the Lower Aquifer, than in the UWBZ. For example, arsenic, cadmium, and zinc are present in UWBZ monitoring well HS-11(S) greater than the HCOPC screening level, but are not detected or detected at much lower concentrations at MW-28T and seep N003. In addition, the low levels of ammonia detected at UWBZ well HS11(S) do not correspond to the presence of ammonia greater than the HCOPC screening level at MW-28T and seep N003. Therefore, the Lower Aquifer is the likely source of seep N003.



**Illinois EPA Review:** *Response is acceptable pending review of response to additional comment raised in 57b, above.*

**Review Response:** This section will be revised to read: "A comparison of the groundwater concentrations upgradient of UPSEA springs N003, N004, and N005 suggests that these springs most likely receive contributions from both the UWBZ and the Lower Aquifer as follows:

- N003: As shown in Table 5-9A, the concentrations of barium measured at N003 are more similar in concentration to UWBZ wells W-18(S) and MW-39U than to the Lower Aquifer monitoring wells, whereas the concentrations of zinc, ammonia, phosphorus, and sulfate measured at N003 are similar to concentrations of these analytes measured in Lower Aquifer monitoring wells MW-27T and W-18(D). The manganese results from N003 were similar to data obtained from both the UWBZ and Lower Aquifer, but the concentrations of iron measured at N003 are not similar to the groundwater data obtained from either aquifer.

**Response (to 76 d continued from above):**

- N004: A comparison of the concentration of arsenic, manganese, zinc, ammonia, and sulfate between UPSEA seep N004 and upgradient monitoring wells HS-12(S) (UWBZ) and HS-13(I) (TOLA) indicates that the concentrations measured at seep N004 are more similar to the concentrations measured in TOLA monitoring well HS-13(I) than UWBZ well HS-12(S). For example, arsenic was detected greater than the HCOPC screening level at HS-12(S), but was not detected at HS-13(I) and N004. Furthermore, the concentration of manganese, zinc, ammonia, and sulfate at N004 are more similar to the concentrations detected at HS-13(I) than HS-12(S).

**Illinois EPA Review:** *Response is acceptable pending review of response to additional comment raised in 57b, above.*

**Review Response:** The response to the comment above will be revised to read:

- N004: As shown in Table 5-9B, the concentrations of arsenic, manganese, ammonia, and phosphorus measured at N004 are more similar to the concentration of these analytes detected in the Lower Aquifer than the UWBZ, and the concentrations of aluminum, copper, iron, lead, and zinc measured at N004 are not similar to the groundwater data obtained from either aquifer. The barium results from N004 were similar to data obtained from both the UWBZ and Lower Aquifer. The concentration of sulfate measured at N004 is more similar to, but greater than, the data obtained from UWBZ monitoring well HS-12(S). In addition, the presence of reddish discoloration in spring N004 in November 2012 similar to the reddish discoloration in the eastern settling pond, SP-2, suggests that there is a potential contribution from the eastern settling pond to spring N004.

**Response (to 76 d continued from above):**

- N005: A comparison of the concentration of iron, manganese, zinc, ammonia, and sulfate between UPSEA seep N005 and upgradient UWBZ well W-18(S), TOLA well MW-27T, and BOLA well W-18(D) indicates that the concentration of these analytes detected at N005 are more similar to the concentrations detected at Lower Aquifer monitoring wells MW-27T and W-18(D) rather than UWBZ monitoring well W-18(S), indicating that the Lower Aquifer is the likely source of water at seep N005."

**Illinois EPA Review:** *Response is acceptable pending review of response to additional comment raised in 57b, above.*

**Review Response:** The response to the comment above will be revised to read:

- N005: As shown in Table 5-9C, the concentrations of barium, cobalt, manganese, nickel, zinc, fluoride, phosphorus, and sulfate are more similar to the concentrations measured in the Lower Aquifer monitoring wells than the UWBZ monitoring wells, and the concentrations of ammonia measured at N005 are not similar to the groundwater data obtained from either aquifer. With the exception of the iron concentration measured at W-18(S) in August 2007, the concentrations of iron measured at N005 are generally similar to the concentrations measured in the UWBZ and the Lower Aquifer.

**Comment 78.** *Section 6.5.2.1, Eastern Area Non-Native Materials, page 91: Based on Section 4.2.2, there is no non-native material data for paste pH or sulfur speciation. The text should not conclude that acid will not be generated. This should be revised to conclude that given the types of non-native materials here, acid generation is likely.*

**Response:** Paste pH and sulfur speciation samples were not obtained from the Eastern Area during the Phase II RI as outlined in the IEPA-approved work plan. Seventy-two paste pH samples were obtained from the non-native soil and 93 paste pH samples were obtained from the native soil in the Eastern Area during the Phase I RI. Paste pH results from 4 (two non-native and two native) of 165 soil samples were equal to or less than 4.5 SU indicating that the soil at these isolated locations may produce acid, but in general, the soil in the Eastern Area is not acid producing. As a result, the text will not be revised to indicate that acid generation is likely.

**Illinois EPA Review:** *There were two non-native Eastern Area sample locations with a paste pH result of 4.5 or less. So a potential to produce acid exists; however, no sulfur speciation samples were collected as support. The sample at D-5 was collected at the surface; the sample collected at W-13S was collected from the subsurface. The locations were only approximately 350 feet apart from each other, so whether they were isolated acid-producing locations is unknown. The lack of evaluation of non-native material from the Eastern Area for acid generating potential is a data gap. A sentence similar to the following should be added to the text: "At a few locations the non-native material had a paste pH of 4.5 or less, indicating that some non-native materials could produce acid; however no sulfur speciation samples were collected to verify this result."*

**Review Response:** Fourteen soil samples were obtained from non-native material in the Eastern Area for sulfur speciation and acid generation potential during the Phase I RI as outlined in Table C1-8 included in Attachment 5. These samples include D-3(5-6.5), D-6(0-1.5), D-7(0-1.3), E-2(1.5-5), E-4(5-7.5), E-5(5-6.5), E-6(0.5-2.5), F-2(2.2-3.2), F-3(0.5-5), G-7(3.5-10), P-1(0-0.5), J-6(8-10), P-4(2.5-5), and W-13(S)(5-17.5). The results of the acid-base potential shown on Table C1-8 indicates that the fill tested at four soil boring locations [i.e., E-5, G-7, P-4, and W-13(S)] may produce acid in the future. The acid-base potential results of the remaining 10 samples indicate that those fill materials will not likely produce acid in the future.

The text will be revised as follows:

"Non-native material in the Eastern Area consists of slag, lithopone, and general fill. The general fill consists of demolition debris, slag, other residues and soil. Samples of the non-native material in the Eastern Area were not obtained during the Phase II RI. During the Phase I RI, 72 paste pH soil samples were obtained from the non-native soil and two out of the 72 soil samples exhibited a paste pH equal to or less than 4.5 SU. In addition, 14 soil samples of non-native materials were analyzed for sulfur speciation and acid generation potential during the Phase I RI as summarized in Table C1-8 in Appendix V. The results of the acid-base potential of the non-native materials in the Eastern area indicate that four of the 14 soil borings may produce acid in the future and materials at 10 of the 14

soil boring locations will not produce acid in the future. Based on the data obtained during the Phase I RI, some non-native materials in the Eastern Area could produce acid."

**Comment 79.** Section 6.5.2.2, Eastern Area Native Materials, page 92:

*b) This paragraph doesn't address the actual data that was collected. Figure 4-7 and 4-11 show areas of the Eastern Area that have no peat and 0 feet of aquitard so the text should not say that the aquitard is present throughout the area. Sequential batch test show that the aquitard has some sequestration capacity for zinc and cadmium, but also has the potential to leach other metals. There is a downward vertical gradient between the UWBZ and the TOLA, and there are metals and sulfate in the Lower Aquifer. Obviously at some locations in this area the aquitard is not effective. This section should be revised to highlight the data that shows how contaminants may be migrating to the Lower Aquifer.*

Response: The text in Section 6.5.2.2 will be edited as follows: "The aquitard is present throughout the Eastern Area and consists mainly of silty sand and silty clay. In some area as shown on Figure 4-11, a peat layer is also present and is part of the aquitard. The aquitard is present throughout the majority of the site and limits the interaction between the UWBZ and the Lower Aquifer. In the southwest corner of the Slag Pile Area, the aquitard unit was not encountered at soil borings J7, SB-11, and SB-38/MW-37U. A downward vertical gradient is present between the UWBZ and the Lower Aquifer in the Lithopone Ridges Area, in the Eastern Area north of the Slag Pile, the northern portion of the Slag Pile Area, and the southwest corner of the Slag Pile Area where the aquitard is not present. These are the areas where COPCs from the UWBZ have the greatest potential to migrate to the Lower Aquifer."

**Illinois EPA Review:** *The Aquitard is not present throughout the Eastern Area. An overlay of Figures 4-7 and 4-11 show areas that have no peat and 0 feet of Aquitard. For example, there is no peat present at H-5, and per the boring log, the clay identified as Aquitard from 4.2-4.7 feet in Table 4-2C is actually above the UWBZ.*

Review Response: See the response to Comment No. 16 above and the revised Figure 4-7 included in Attachment 1. Upon further review of the boring log for soil boring H-5, the clay layer encountered from 4.2 to 4.7 feet below ground surface (bgs) and identified as the aquitard in the Phase I RI is at a higher elevation than the elevation of the top of the aquitard at nearby soil borings such as SB-46/MW-43U, W-21D, and H-6. However, the sandy silt layer encountered at 8 feet bgs (468.2 amsl) is at the approximate same elevation as the aquitard identified at nearby Phase II RI location SB-46/MW-43U (466.13 amsl) and at H-6 (469.1 amsl). Therefore, this sandy silt unit encountered at H-5 has been interpreted to be aquitard material. The geologic description for H-5 indicated that the sandy silt was grading to silty fine to medium sand, but did not identify a depth where the sandy silty changed completely to sand; however, a gravel zone was encountered from 11.3 to 11.7 feet bgs. Based on the lack of detail in the boring log for H-5 below 8 feet bgs, the bottom of the aquitard layer was selected to be at the top of the gravel zone encountered at 11.3 feet bgs (i.e., 464.87 amsl). Table 4-2C and Figure 4-7 have been revised accordingly to show that 3.3 feet of aquitard is present at H-5. As shown on Figure 4-7 in Attachment 1, the Aquitard is present throughout the Eastern Area.

**Comment 80.** Section 6.5.3, Eastern Area Groundwater, page 92:

*c) The last paragraph of this section discusses the vertical gradient between the UWBZ and the TOLA in the UPSEA, but ignores the neutral to downward gradient within the Lower Aquifer (e.g., HS-13(I)/MW-29B). If some component of flow from the Lower Aquifer is seepage (assumed to be slight) across the aquitard or discharge via seeps, then what happens with the other component of flow within the Lower Aquifer? If it is discharging to the Illinois River, the location is unknown, given*

*the recent DSDA drilling data. If it is assumed it discharges to the lake, there is limited evidence provided in the report to support this. A more thorough interpretation or explanation of the data should be provided.*

**Response:** The last paragraph will be revised as follows: "As depicted on Figure 6-4, groundwater in the Lower Aquifer in the Eastern Area flows south through a portion of the Western Area and towards the Village of DePue, DePue Lake, and the Illinois River. The vertical gradient between the Lower Aquifer and the UWBZ in the UPSEA is upward; and soil borings drilled on the peninsula south of Lake DePue in May 2012 as part of OU2 investigation activities confirmed that the Lower Aquifer does not extend to the south side of the lake. Therefore, the Lower Aquifer groundwater discharges to the seeps, springs, and wetlands along the north shore and east end of the lake and diffuses upward through the Aquitard along the fringe of the lake and within the lake."

**Illinois EPA Review:** *Figure 6-4 should be revised to show the truncation of the Lower Aquifer. If the intention is to use the proposed OU2 report conclusion (i.e., discharge to stream channel, springs, seeps and wetland soils), it should be acknowledged in the OU3 report revision that this proposed conclusion is still under investigation.*

**Review Response:** The results of the drilling in the peninsula south of DePue Lake and the results of the seep sampling indicate that groundwater is discharging to the Lake. A revised Figure 6-4 has been prepared and is included in Attachment 1. The text will be changed to read:

"As depicted on Figure 6-4, groundwater in the Lower Aquifer in the Eastern Area flows south through a portion of the Western Area and towards the Village of DePue, DePue Lake, and the Illinois River. The vertical gradient between the Lower Aquifer and the UWBZ in the UPSEA is upward; and soil borings drilled on the peninsula south of Lake DePue in May 2012 as part of OU2 investigation activities confirmed that the Lower Aquifer does not extend to the south side of Lake DePue. Therefore, the Lower Aquifer groundwater discharges to the seeps, springs, and wetlands along the north shore and east end of the lake and diffuses upward through the Aquitard along the fringe of the lake and within the lake."

**Comment 81.** Section 6.6.3, Western Area Groundwater, page 93:

*b) The vertical gradient in the Lower Aquifer near Lake DePue is neutral/downward, not upward (MW-44T/B, MW-46T/B). Refer to the previous comments on Figures 6-3 and 6-4 regarding the source of shoreline seeps, the uncertainty of Lower Aquifer discharge, and the dimensions of the Illinois River relative to Lake DePue.*

**Response:** See response 81C.

**Illinois EPA Review:** *It is assumed that the response to this comment refers to the response to comment 80(c). Refer to the review of response to comment 80(c).*

**Review Response:** See the Review Response to comment 80c.

**Comment 82.** Section 6.7, Off-Site East Area, page 94: *Arsenic was also detected at MW-51B at concentrations exceeding the HCOPC screening level, and should be mentioned in the text.*

**Response:** Section 6.7 will be edited as follows: "East of the UPSEA, iron, manganese, ammonia, and sulfate are present in the Lower Aquifer greater than the HCOPC screening levels at MW-51T and MW-51B. Arsenic was also detected greater than the HCOPC screening level at MW-51B, but less than the Class I groundwater standard of 50 ug/L (35IAC Part 620.410) during three of the four groundwater sampling events. Downgradient of MW-51T/MW-51B, one or more of these parameters

are detected in the Lower Aquifer greater than the HCOPC screening level at MW-49B, MW-50T, and MW-50B. At MW-50T/MW-50B, the concentration of iron, manganese, and sulfate is greater in the BOLA than the TOLA. In the UPSEA, the concentration of ammonia and sulfate in the TOLA and BOLA monitoring wells are similar whereas the concentration of iron and manganese is similar or higher in the BOLA than the TOLA. OU2 is the potential source of ammonia and sulfate in the area east of the FPSA and UPSEA. The presence of iron and manganese in groundwater does not coincide with the presence of OU2-related compounds; therefore, iron and manganese are considered indicative of ambient conditions in the Lower Aquifer."

**Illinois EPA Review:** *The final sentence of the response regarding the presence of iron and manganese in groundwater as being indicative of ambient conditions is inaccurate and should be removed from the text revision.*

**Review Response:** As requested, the final sentence of the response will be removed from the text revision.

**Comment 83.** Section 6.8, Lower Aquifer Discharge to DePue Lake, page 94:

*a) The current interpretation provided by the DePue Group is not supported by the data. A comparison of groundwater and seep sampling results reveals that UWBZ wells upgradient of the shoreline seeps (i.e., MW-23U, MW-24U, W-17S in the southern portion of the Eastern Area) show cadmium, lead, manganese, and zinc exceedances of the HCOPC screening levels. The shoreline seeps SP-03 through SP-10 have many of these same metals with exceedances of HCOPC screening levels, or concentrations that are elevated above expected concentrations. Further, the shoreline seeps do not show any exceedances of ammonia or sulfate, but these are observed at TOLA/BOLA wells upgradient of the shoreline seeps (i.e., MW-23T, MW-45B, MW-46T/B, MW-48T/B, and MW-47T/B) along with manganese, and to a lesser extent iron. Consequently, it appears that the COPC constituents in the shoreline seeps more closely resemble those in the UWBZ, not the Lower Aquifer, suggesting a source in the UWBZ (or similar fill materials within the village?). Site-related fill materials have been observed in excavations made by the Village Water Department and 4 to 5 feet of fill is observed in wells MW-46T/B, MW-48T/B, and MW-47T/B (although no water was seen at the time of drilling). Although there may be isolated locations where the aquifer discharges to the lake, the vertical gradients within the Lower Aquifer are predominantly downward along the lakeshore. This coupled with the observed metal concentrations does not provide strong evidence that discharge at the shoreline seeps is from the Lower Aquifer. If the DePue Group concludes that the Lower Aquifer discharges at the seeps, then evidence for the source of these contaminants should be provided in the report.*

**Response:** The above comment indicated that ammonia and sulfate were observed at TOLA/BOLA wells upgradient of the shoreline seeps (i.e., MW-23T, MW-45B, MW-46T/B, MW-48T/B, and MW-47T/B) above HCOPC screening levels. To clarify, ammonia and sulfate have not been detected at MW-23T, MW-45B, and MW-46T/B at concentrations greater than the HCOPC screening level. Ammonia and sulfate at MW-48B were detected at concentrations greater than the HCOPC screening level in November 2010, but based on the results of the three remaining sampling events, the results from the November 2010 sampling appear anomalous. Sulfate has been detected at MW-47T greater than the HCOPC screening level.

With regards to the source of the shoreline seeps, the hydrogeologic data and the shoreline seep observations obtained at the site do not support the conclusion that the UWBZ is the source of the shoreline seeps for the following reasons:

- While the concentrations of cadmium, lead, manganese, and zinc measured in the shoreline seeps SP-03 through SP-10 may be more similar to the concentration of these compounds at

Eastern Area UWBZ wells MW-23U, MW-24U, and W-17(S) than the concentrations measured in the lower aquifer, the UWBZ has not been identified within the residential portion of the Village of DePue and upgradient of the shoreline seeps. Therefore, the UWBZ is not continuous and does not provide a pathway for migration from the UWBZ to the shoreline seeps.

- The results of the shoreline seep monitoring indicated that the seeps were observed to be flowing throughout the monitoring period except when the seeps were flooded by DePue Lake. A continually saturated UWBZ would be required to result in continuously flowing seeps, which was not observed during drilling.
- The vertical gradients between the UWBZ and the Lower Aquifer in the UPSEA are upward and artesian conditions are present at MW-45B, located in Lake Park, MW-49B, and MW25T/B and the groundwater elevations measured in the Lower Aquifer monitoring wells near the shoreline distance (i.e., MW-45B, MW-46T/B, and MW-48T/B are approximately 8 to 10 feet higher than the seep elevations shown on Figure 4-12. Furthermore, the soil borings drilled on the peninsula south of Lake DePue in May 2012 as part of OU2 investigation activities confirmed that the Lower Aquifer does not extend to the south side of the lake.

Based on this information, the Lower Aquifer is the source of groundwater discharges to the seeps, springs, and wetlands along the north shore and east end of the lake and discharges upward through the Aquitard along the fringe of the lake and within the lake. The Division Street Drain or materials placed along the shoreline are potential sources of compounds such as cadmium and lead to the shoreline seeps.

**Illinois EPA Review:** *The presence of metals in the seeps must be accounted for because concentrations exceed HCOPC or ECOPC screening criteria; if it is speculated that their presence is the result of the Division Street Drain or site-related materials placed along the shoreline then this must be stated in the revised report. As stated in a previous comment, definition of the nature and extent of off-site lake-shore source areas, particularly for seeps SP-02 through SP-06, has not been completed and there currently appear to be no plans in place under OU3, OU4, or OU5 to address this data gap.*

**Review Response:** See review response to General Comment 2.

*b) The elevations of all the seeps should be provided in the report to help substantiate the origins of the seeps relative to the stratigraphy encountered.*

**Response:** The elevations of the shoreline seeps will be incorporated into Table 4-12. A comparison of the shoreline seep elevations to the groundwater elevations for MW-45B, MW-46T/B, and MW-48T/B shown in Table 4-10 indicates that the groundwater elevation is higher than the seep elevation indicating upward gradients from the Lower Aquifer to the shoreline seeps.

**Illinois EPA Review:** *The elevations of these shoreline seeps should be field-verified to ensure that the elevation of the head of the seep is measured, not only the sampling point.*

**Review Response:** The elevations of the shoreline seeps were measured by Chamlin & Associates in July 2010 and are incorporated in Table 4-12. The elevation measurements were taken at the approximate head of the seep determined at the time of the survey. The photographic log included in Appendix H of the Preliminary Phase II RI shows the relationship of some of the survey points to the seep location.

*c) What are the sources of the UPSEA seeps?*

Response: The Lower Aquifer is the source of the UPSEA seeps investigated.

**Illinois EPA Review:** *Response is acceptable pending review of response to additional comment raised in 57b, above.*

Review Response: See Response to Comment 57b above.

*d) There will be little additional information coming from the OU2 investigation that is not already available; there are already 7 rounds of sample data from UPSEA and other wells in the Lower Aquifer. Any further interpretation based on the OU2 investigation should be made in the revision of this report.*

Response: The soil borings drilled on the peninsula south of Lake DePue in May 2012 as part of OU2 investigation activities confirmed that the Lower Aquifer does not extend to the south side of the lake. Therefore, the Lower Aquifer groundwater discharges to the seeps, springs, and wetlands along the north shore and east end of the lake and discharges upward through the Aquitard along the fringe of the lake and within the lake.

**Illinois EPA Review:** *A stated previously, if the intention is to use the proposed OU2 report conclusion (i.e., discharge to stream channel, springs, seeps and wetland soils), it should be acknowledged in the OU3 report revision that this is still under investigation under OU2.*

Review Response: The results of the soil borings drilled on the peninsula south of Lake DePue in May 2012 and the groundwater data from the N series seeps confirm the conclusions in the response. No further text changes are proposed.

**Comment 84.** *Section 7, page 95, Summary and Conclusions, page 95: Based on the review comments above, there are several statements made in the summary that should be revised, and additional conclusions should be included. These are as follows:*

Hydrological Investigation

*a) There are areas where the vertical hydraulic conductivity of the aquitard is only 2 orders of magnitude less than that of the fill. Areas where the aquitard may be less competent are more important in defining the hydrologic setting because they likely are areas where contaminants migrate to the Lower Aquifer.*

Response: The first paragraph in this section will be edited as follows: " The thickness and hydraulic properties of the aquitard underlying the site is complete and the results of the evaluation are summarized on Figure 4-7. The mean vertical hydraulic conductivity of the aquitard is approximately four orders of magnitude less than that of the fill and naturally occurring sands. In general, the aquitard, where present, limits downward migration of groundwater and dissolved constituents. The areas of the lowest vertical hydraulic conductivity of the aquitard are located at SB-01/MW-20B in the southwest corner of the site (Western Area); SB-10/MW-24U located in the southern extent of the Eastern Area; B-4, SB-30/MW-30T, SB-28/MW-41U, SB-29, W-20(I), and SB-32 in the Lithopone Ridges Area; PZ-01(I) on the northwest corner of the Slag Pile and J10 and J11 south and southeast of the Slag Pile; and L3 and SB-37/MW-36T in the UPSEA. Areas of higher vertical hydraulic conductivities in the range of  $10^{-5}$  to  $10^{-6}$  cm/sec are located at SB-6 in the western portion of the Eastern Area and SB-7 in the central portion of the Eastern Area; SB-4 at the eastern extent of the Western Area; PZ-04(I) and J8 in the southwest corner of the Slag Pile and PZ-02(I) northeast of the Slag Pile, and SB-23/MW-27T, W-18D, and SB-24/MW-28T at the southern extent of the UPSEA.



The aquitard is not present in the southwest corner of the Slag Pile Area at J7, SB-11, and SB-38/MW-37U and in the Vanadium Pentoxide Catalyst Disposal Area. The location of where the peat is present is shown on Figure 4-11. Based on this information, the aquitard, where present and competent, retards the vertical migration of water and dissolved metals. The areas of the greatest potential for vertical migration of COPCs through the aquitard and into the Lower Aquifer are in the vicinity of the southwest corner of the Slag Pile Area and the Vanadium Pentoxide Catalyst Disposal Area where the aquitard is not present and areas where higher vertical hydraulic conductivities were measured in the Aquitard, such as the northern portion of the Slag Pile Area, the southern portion of the UPSEA; and the western and central portions of the Eastern Area.

**Illinois EPA Review:** *The revision should not only talk about areas with “the greatest potential for vertical migration”, it should also summarize the areas where migration is currently or has taken place, i.e., southwest corner of Slag Pile, northern portion of Slag Pile, central Eastern Area, Lithopone Ridge Area. Refer to earlier reviews of response to comments regarding the revision of existing thickness of Aquitard and peat figures, the presentation of such data, and the interpretation of this data (e.g., 16, 17, 35).*

**Review Response:** The following sentence will be added to the end of the response above:

“Based on the concentrations of HCOPCs detected in the Lower Aquifer, it appears that migration is currently or has taken place in the southwest corner of Slag Pile, northern portion of Slag Pile, central Eastern Area, and Lithopone Ridge Area.”

**Comment 84 b)** *What is a “sufficient thickness”? There are areas where the peat and aquitard are absent or thin. These should be identified because they will be the most important for the future feasibility study.*

**Response:** See response for 84a.

**Illinois EPA Review:** *The response to comment 84a) addresses the hydraulic conductivity range of the Aquitard, and where the peat and Aquitard are missing, but does not discuss/identify thin areas. The response to comment 80b) addressed the thinness issue and that language should be included here in the conclusions*

**Review Response:** The text provided in the response to comment 80b will be incorporated into the conclusions.

**Comment 84 d)** *The extent of the UWBZ south of the Marquette St. fence in the southern portion of the Eastern Area should be delineated and described in the summary.*

**Response:** See response for 84a.

**Illinois EPA Review:** *The response is not adequate. The response for 84a does not address the extent of the UWBZ south of the Marquette Street fence in the southern portion of the Eastern Area.*

**Review Response:** As previously discussed with IEPA and included in the Work Plan, four additional soil borings (SB-5, SB-6, SB-9, and SB-10) were installed during the Phase II RI to refine the lateral extent of the UWBZ. The soil borings for SB-9 and SB-10 were converted into UWBZ monitoring wells MW-23U and MW-24U and were sampled five times during the Phase II RI. The results of the installation and sampling were transmitted to IEPA in four quarterly technical memoranda and the Groundwater Technical Memorandum (GWTM) (ENVIRON, 2010). The GWTM was approved by IEPA in April 2010. Section 4 of the GWTM also included a proposed Off-Site Groundwater

Sampling Program. As outlined in Section 4.1.2 of the GWTM, the off-site well location MW-46 was selected because it is downgradient of UWBZ monitoring wells MW-23U, MW-24U, and W-17(S) and the MW-47 location is downgradient of PZ-4(S) and west of W-18(S). The UWBZ was not encountered at the MW-46 and MW-47 drilling locations; therefore, a TOLA and a BOLA wells were installed at each location, but a UWBZ monitoring well was not. The UWBZ was also not encountered in the other off-site monitoring locations. The results of the off-site groundwater sampling were transmitted to IEPA in four quarterly technical memoranda. Based on the findings of the lithology at the MW-46 and MW-47 locations, the UWBZ ends somewhere between MW-23U/MW-24U/W-17(S) and W-18(S) and the MW-46/MW-47 locations. It is not necessary to delineate the exact location of the termination of the UWBZ. The following text will be added to the end of Section 3.8.2: "The UWBZ was not encountered at the off-site monitoring well locations; therefore, UWBZ monitoring wells were not installed. The extent of the UWBZ south of Eastern Area monitoring wells MW-23U/MW-24U/W-17(S) and west of UPSEA monitoring well W-18(S) ends somewhere between MW-23U/MW-24U/W-17(S) and W-18(S) and off-site monitoring well locations MW-46 and MW-47."

**Comment 84 e)** *Vertical gradients between the UWBZ/TOLA and TOLA/BOLA should be summarized in terms of their potential contribution to contaminant migration and discharge of the UWBZ and Lower Aquifer. Discharge for both water-bearing units should be specifically defined.*

**Response:** The following text will be added to this section as follows:

- Vertical gradients between the UWBZ and the Lower Aquifer are downward in the Bluff Area, Lithopone Ridges Area, and the central portion of the Eastern Area located between the Lithopone Ridges Area and the Slag Pile Area. A downward vertical gradient was also observed between the UWBZ and TOLA at the PZ-04 well cluster located southwest of the Slag Pile Area. Upward vertical gradients between the UWBZ and Lower Aquifer are present in the southern portion of the Eastern Area along Marquette Street, in the Slag Pile Area, and the UPSEA. The locations where downward vertical gradients are present between the lower aquifer and the UWBZ are areas where migration from the UWBZ to the lower aquifer is more likely.

**Illinois EPA Review:** *Again, the conclusions should include a discussion of the areas where migration to the Lower Aquifer due to vertical gradients has been observed, not just where it's "more likely".*

**Review Response:** See response to comment 84a.

**Response (to 84e continued from above)**

- The direction of groundwater flow in the UWBZ is to the south to the UPSEA, ultimately discharging to DePue Lake.

**Illinois EPA Review:** *What happens to the flow of the UWBZ to the south of the south central portion of the Eastern Area (south of MW-23U/MW-24U), as there is a data gap in this off-site area.*

**Review Response:** See response to comment 84d.

#### On-Site Groundwater Investigation

**Comment 84 g)** *What is meant by "the vertical extent of impact for some parameters is limited vertically by the bedrock..."? It's pretty clear that in the Lower Aquifer, FPSA related metals and sulfate are observed in the TOLA and that Gypstack related parameters (arsenic, iron, manganese, ammonia, and sulfate) are observed principally in the BOLA. It should be noted that the BOLA also contains lower yet elevated concentrations of some metals (e.g., zinc at W-18D, W-21D) at some*

*locations. The water quality impacts in the TOLA should be summarized, including the metals identified, sources for these metals, the extent and fate of contaminant plume(s), and trends in concentrations. Include a similar summary for the BOLA. Metals and sulfate concentrations that are greater than background/upgradient wells should also be summarized even if they don't exceed the HCOPC screening level. The Gypstack plume is also found below the FPSA, this should be included in the summary.*

**Response:** The "On-Site Groundwater Investigation section will be revised as follows:

- Arsenic, cadmium, iron, manganese, nickel, zinc, ammonia, fluoride, nitrate/nitrite, and sulfate were consistently detected at concentrations greater than their respective HCOPC screening levels in the TOLA. The lateral extents of arsenic, nickel, zinc, fluoride, and nitrate/nitrite at concentrations greater than the HCOPC screening level in the TOLA are delineated and are delineated to the HCOPC screening level to the south, prior to reaching DePue Lake. The lateral extents of cadmium, iron, manganese, ammonia, and fluoride are not delineated to the south prior to reaching DePue Lake in the TOLA. With the exception of the iron concentration at HS-13(I) and MW-27T, no trend or a decreasing concentration trend is present for these compounds in the TOLA. The Lithopone Ridges, Slag Pile Area, and/or UPSEA are the source of these compounds in the TOLA with a contribution from OU2 for ammonia and sulfate.
- Arsenic, barium, iron, manganese, ammonia, and sulfate were consistently detected at concentrations greater than their respective HCOPC screening levels in the BOLA. The extent of arsenic in the BOLA is isolated to the vicinity of W-12(D) in the Bluff Area; and the extent of iron, manganese, ammonia, and sulfate in the BOLA is not delineated to the south and to the east. Cadmium, nickel, zinc, fluoride, and nitrate/nitrite are not present in the BOLA at concentrations greater than HCOPC screening levels. Barium at MW-20B in the BOLA is present at concentrations greater than the HCOPC screening level, but is delineated to the south and east and does not extend to DePue Lake.

**Illinois EPA Review:** *The responses in these first two bullets include no discussion of contaminant delineations to the east or west. Review of the portion of the response concerning the trend evaluation is pending an evaluation of the Mann-Kendall analysis to be included as Appendix U in the revised report. Portions of the Eastern Area can also be considered a source for these compounds in the TOLA.*

**Review Response:** The discussion of the lateral extent of the analytes discussed was in reference to the east-west delineation of the analytes discussed. For clarity, the responses and report text will be revised as follows:

- Arsenic, cadmium, iron, manganese, nickel, zinc, ammonia, fluoride, nitrate/nitrite, and sulfate were consistently detected at concentrations greater than their respective HCOPC screening levels in the TOLA. Concentrations of arsenic, cadmium, nickel, zinc, fluoride, and nitrate/nitrite greater than the HCOPC screening level are delineated to the east and west within the footprint of the FPSA. Concentrations of iron greater than the HCOPC screening level are delineated to the west, but not to the east. Concentrations of manganese are not delineated to the east or west, and concentrations of ammonia are delineated to the west and east, but ammonia concentrations increase again east of the footprint of the FPSA. The downgradient extents of arsenic, cadmium nickel, zinc, fluoride, and nitrate/nitrite at concentrations greater than the HCOPC screening level in the TOLA are delineated to the HCOPC screening level to the south, prior to reaching DePue Lake. The downgradient extents of iron, manganese, ammonia, and sulfate are not delineated to the south prior to reaching DePue Lake in the TOLA. Therefore, they have been defined in OU5. With the exception of the iron concentration at HS-13(I) and MW-27T, no trend or a decreasing concentration trend is present for these analytes in the TOLA.